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Mood, meth, condom use, and gender: Latent growth curve modeling results from a randomized trial

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Abstract

Methamphetamine use poses increased risk for HIV and other sexually transmitted infections. There is robust evidence that methamphetamine use increases sexual risk behavior, like condomless sex, primarily among men who have sex with men but also among heterosexual women and men. Gender differences have been found among women and men who use meth, and there is a high degree of interconnectedness between meth use, depression, and condomless sex. The aims of the current study are to evaluate the efficacy of a theory-based, tri-focal intervention designed to reduce depression, meth use, and condomless sex among women and men, and to examine gender as a moderator of efficacy. A total of 432 HIV-negative women and men who use meth participated in a two-arm randomized controlled trial and completed baseline and follow-up assessments at 4, 8, and 12 months. We used latent growth curve modeling techniques to analyze the data. Results showed that while all participants exhibited reductions in depression, meth use, and condomless sex, the intervention and comparison groups did not differ in changes over time. However, we did find a significant gender moderation effect, such that among men, those in the intervention arm reported greater reductions in meth use relative to those in the comparison group; reduced meth use was associated with reduced condomless sex, but not depression. In contrast, women in the intervention condition did not differ from women in the comparison condition in changes in any of the three outcome variables. Interventions targeting heterosexual women and men who use meth must be gender-specific, and take into account the unique vulnerabilities and experiences of women, including the perceived positive aspects of using meth, gendered power dynamics, higher depression, and violence.

Abstract

El uso de metanfetaminas incrementa el riesgo de VIH y otras enfermedades de transmisión sexual. Existe evidencia robusta que el uso de metanfetaminas incrementa las conductas sexuales

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de riesgo, como las relaciones sexuales sin condón, principalmente entre los hombres que tienen sexo con hombres, pero también entre las mujeres y hombres heterosexuales. Se han encontrado diferencias de géneros entre los las mujeres y hombres que usan metanfetaminas, y existe un alto grado de interconexión entre el uso de metanfetaminas, la depresión, y las relaciones sexuales sin condón. Los objetivos del presente estudio son: 1) Evaluar la eficacia de una intervención tri-focal basada en teoría diseñada para reducir la depresión, el uso de metanfetaminas, y las relaciones sexuales sin condón entre mujeres y hombres, y 2) examinar el género como un moderador de la eficacia. Un total de 432 mujeres y hombres sin VIH que utilizan metanfetaminas participaron en un ensayo aleatorizado controlado de dos brazos y completaron evaluaciones al inicio del estudio y a las 4, 8, y 12 meses. Utilizamos un modelo de curvas latentes de crecimiento para analizar los datos. Los resultados demostraron que mientras todos los participantes exhibieron reducciones en la depresión, uso de metanfetaminas, y relaciones sexuales sin condón, no hubo cambios a través del tiempo entre el grupo de intervención y el de comparación. Sin embargo, encontramos un efecto de moderación de género significativa, tal que los hombres en el grupo de intervención reportaron una reducción mayor en el uso de metanfetaminas relativa a los hombres en el grupo de comparación; la reducción en el uso de metanfetaminas estuvo asociado con la reducción de las relaciones sexuales sin condón, pero no de la depresión. En contraste, no hubo diferencia entre las mujeres en el grupo de intervención y el grupo de comparación en alguna de las variables dependientes. Las intervenciones enfocadas a las mujeres y hombres heterosexuales que utilizan metanfetaminas deben de ser específicas de género, tomando en cuenta las vulnerabilidades y experiencias únicas de las mujeres, incluyendo las percepciones positivas del uso de metanfetaminas, dinámicas de poder entre géneros, niveles mayores de depresión, y violencia.

Introduction

Methamphetamine use has long been linked to increased sexual risk behavior and risks for HIV and other sexually transmitted infections (STIs) (1,2). Meth heightens libido, impairs judgment, delays sexual climax (3–5), and therefore is associated with more sexual partners, sexual activity including anal sex, condomless sex, and condom breakage (2,6,7). The evidence for the association between meth use and sexual risks for HIV is robust among men who have sex with men (MSM). Consequently, behavioral HIV prevention interventions have been designed to focus on reducing HIV risk among meth-using MSM (8–11). Although relatively fewer in number compared to relevant research with MSM, research has also demonstrated the important role of meth use in sexual risks for HIV among heterosexual women and men (12).

A recent meta-analysis of studies of heterosexual meth users published since 2000 showed that the odds of engaging in risky sex for heterosexual users is on average between 37% to 72% greater than for non-meth users (13). Similar to MSM, heterosexual women and men experience a heightened sex drive and increased sexual activity while on meth (12). Compared to other drug users, heterosexual women and men who use meth report a greater number of sexual partners, condomless sex acts, and casual or anonymous partners (14). Motivations for using meth appear to differ between heterosexual women and men. Whereas both women and men report a desire to enhance sexual pleasure (12,15,16), women also report feeling greater sexual empowerment and agency while on meth (17,18), suggesting

the need to recognize gender differences between meth users. Despite any differences, like men, heterosexual women who use meth also engage in high risk behaviors associated with HIV/STI acquisition, including more sex partners and transactional sex (16,19). Even among drug-using women, women who use meth appear to engage in riskier sexual behavior. Meth-injecting women report more anal sex, condomless anal and vaginal sex, and sex partners relative to non-meth-injecting women (20).

In light of the increased risk for HIV faced by heterosexual meth-using women and men, our research team developed and evaluated a theory-based sexual risk reduction intervention for this population, known as *Fastlane*. Results of the *Fastlane* randomized trial showed that participation in the experimental condition (i.e., the *Fastlane* intervention) was associated with significantly more total condom-protected sex acts at six-month follow-up compared to the attention-control diet and exercise condition (21). However, evidence also showed that regardless of group assignment, participants whose meth use and/or depressive symptoms did not decrease over time also did not reduce their condomless sex. These findings were consistent with the literature that has demonstrated the close links between meth use, depression, and sexual risk behavior.

Individuals who use meth engage in risky sexual behavior, and are also more likely to report depressive symptoms or negative mood (2,22,23). These three variables (depression, meth use, risky sex) co-occur among MSM, and also among heterosexual women and men. It is likely that the three reinforce one another (24); meth may be used to cope or distract oneself from a depressive state, meth use increases sexual activity and risks, and negative life conditions and circumstances stemming from meth use prolong depression. This possible interconnectedness suggests that by intervening upon and reducing one variable, reductions should also be found in the other two. In one study, drug treatment for meth-using MSM was associated with fewer anonymous sex partners and reductions in receptive and insertive anal sex acts at one-year follow-up (25). In another study comparing behavioral treatment approaches for meth dependent MSM, drug abuse treatment resulted in significant reductions in both meth use and sexual risk behaviors (23).

In the current paper, we report findings from *Fastlane-II*, a follow-up trial from the original *Fastlane* trial (26), whereby an opportunity to assess the interconnectedness of negative mood, meth use, and risky sex was part of the research design. In *Fastlane-II*, we conducted a randomized trial to evaluate the efficacy of a tri-focal intervention designed to reduce depressive symptoms, meth use, as well as condomless sex among heterosexual women and men. Participants completed a baseline assessment and three post-tests at four month intervals (4, 8, and 12 months). Our primary aims were: 1) To test the overall efficacy of *Fastlane* at reducing all three outcomes of interest; and 2) Examine gender as a moderator of efficacy. The extant literature suggests that women and men may differ in their motivations to and experience of using meth (16,17,19). However, *Fastlane-II* was not tailored to be gender-specific. We therefore hypothesized posthoc that gender would moderate intervention efficacy, in that women would benefit more or less than men from the intervention relative to the comparison group. We used latent growth curve modeling (LGCM), which allows for the analysis of changes over time in parallel processes (e.g., reductions in depressive symptoms, meth use, and condomless sex).

Method

Participants

Participants were eligible for the current study if they: were at least 18 years old; tested negative for HIV at intake; were a self-identified heterosexual woman or man; were sexually active with at least one opposite sex partner in the past two months; and had snorted, smoked, or injected meth at least once during the past two months, and at least once during the past 30 days. Participants were excluded if they: were unwilling to participate in the intervention and follow-up assessments; had current major psychiatric diagnosis accompanied by floridly psychotic symptoms and suicidal ideation within the past two weeks; were not sexually active in the past two months or always used condoms; only had condomless sex with a spouse or steady partner in the past two months; were trying to get pregnant or trying to get a partner pregnant; were currently enrolled in a drug treatment program; and scored 3 or less on the Beck Depression Inventory-Fast Screen (BDI-FS), which indicates mild depressive symptoms. A total of 2,189 individuals were screened for eligibility. Figure 1 summarizes reasons for exclusion.

Recruitment

Participants were recruited using the same methods as the original *Fastlane* trial. Both trials were conducted in San Diego, California. Specifically, community outreach, care and treatment provider networks, participant referrals, posters, “word of mouth,” and walk-ins. Collaboration with community-based agencies that work with substance abuse clients resulted in an effective referral network for potential participants. Providers included substance abuse treatment centers, the needle exchange program, and local case management programs. We also employed a strong social marketing campaign that involved community posters and ads in community newspapers. To emphasize recruitment of ethnic minority participants, we also worked closely with and had the full support of ethnic minority health & social service agencies.

Procedure

Similar to the original trial, *Fastlane-II* utilized a pre-test, multiple post-test, random assignment, comparison/education-only condition design. Figure 1 summarizes participant flow from screening through follow-up and analysis. After determining eligibility, obtaining written informed consent, and completing a baseline assessment, participants were randomly assigned to one of two conditions/conditions: 1) a behavioral intervention program targeting depressive symptoms, meth use, sexual risk behavior, or 2) an education-only comparison condition focused on information about depression, drug addiction and sexual risk behaviors. In each condition, participants participated in a total of nine hour-long one-on-one counseling sessions. The sessions for the experimental condition are described in detail elsewhere (26). A brief description of the intervention and comparison conditions are described below. Participants completed follow-up assessments at 4, 8, and 12 months. Baseline and follow-up data were gathered using audio computer-assisted self-interviewing technology. In total, 432 eligible women and men were randomized into the *Fastlane-II* (n=214) or comparison (n=218) condition and were included in data analysis.

Intervention and Comparison-Education Only Conditions

Intervention (Fastlane-II) condition—Individualized counseling sessions formed the core of our intervention approach. Participants in the experimental condition received our nine-session, tri-focal counseling program. In this condition, counselors utilized techniques associated with Cognitive-Behavioral Therapy (CBT) (26,27), Social Cognitive Theory (28), the Theory of Planned Behavior (29), and motivational interviewing (30) to facilitate desired behavior change in three domains (depression/mood, meth use, sexual risk behavior). Each domain included three separate counseling sessions, and each session lasted about one hour. The nine sessions were completed on a weekly basis.

Domain 1: Reducing Depressive Symptoms

Session 1: Developing a treatment plan.: The first three counseling sessions focused on reducing depressive symptoms/negative mood. Counselors employed a structured agenda, with input from participants into their treatment plan. The first session combined a Socratic teaching style with a motivational interviewing approach, which together facilitated the participant's investment, promoted readiness for change and helped build a client-counselor alliance to support future sessions. First-session discussions focused on building the necessary curriculum-related vocabulary related to the counseling work; hence identifying "hot thoughts," or triggers of negative mood, learning self-observation skills, and familiarizing oneself about how reactions to past events often resulted in risky behaviors with high habit-strength valences. Participants were taught the "OAC" (observe, assess, and change) technique in relation to negative mood. A list of personal problems related to negative mood was generated and each problem was ranked in terms of treatment goals. Participants were required to complete homework assignments, and track mood related activities between counseling sessions. The latter involved keeping a journal that recorded mood and drug use behaviors between sessions.

Session 2: Skill building.: Once the participant agreed to a counseling agenda, treatment goals, and signed a contract, there was a general shift to a cognitive behavioral style of counseling. This client-centered approach utilized skill building, counselor feedback, and structured exercises to promote behavior change. In session 2 (and all subsequent sessions) motivational interviewing techniques were applied in all cases where clients demonstrated ambivalent feelings related to behavior change. Participants were encouraged to be actively involved in each session and to use their own life experiences in discussions and practice exercises. The counselor and participant conducted exercises that enhanced personal insights into triggers of depressive symptoms. Participants were also taught to reframe their interpretation of a personal event to affect its outcome on mood. The counselor provided skill building and practice in the recognition of new ways to deal with negative mood symptoms.

Session 3: Self-control and self-management of negative mood.: Skill building exercises, counselor feedback, and structured exercises were used to promote self-control and self-management of negative mood. Also, when appropriate, counselors included a motivational interviewing approach to the session. Participants learned the four parts of mood-to-action chain: body arousal, thoughts, feelings, and behaviors. Specific exercises were used to

manage negative mood. For example, participants were taught that body arousal can be managed by doing relaxation exercises, or using imagery and symbolism. Additional techniques included talking to a confidant or support buddy and increasing pleasant activities. Depressive symptoms and related problem behaviors were discussed in the context of meth use.

Domain 2: Reducing Meth Use

Session 4: Personal drug history and readiness for change.: In this session, the counselor explored the participant's current and past history of meth use. The goal of this session was to help participants develop insights regarding motivations and triggers of meth use and to evaluate their readiness to change drug use behavior. Participants were taught to recognize their personal triggers of meth use and related hot thoughts; participants then engaged in exercises that support behavior change (e.g., drug use calendar, thought records, alternative activities list) that helped them to see possible links between their meth use and both negative mood, and high risk sexual behavior. A list of alternative activities regarding trigger situations was generated. The counselor and participant explored ways to employ alternative activities and the participant generated subsequent target goals (e.g., alternative activity instead of using meth, seek a support buddy).

Session 5: Management of drug cravings and urges.: This session focused primarily on management of drug cravings and urges using CBT techniques. Skill building included reframing thoughts, avoiding or leaving a high risk situation, engaging in a distracting activity, and delaying the decision to use. The concept of flawed statements (e.g., I am more fun when I am on meth) and automatic chain sequences were introduced. A list of barriers to reducing/stopping meth use was generated; the counselor and participant worked together to problem-solve each barrier by listing advantages and disadvantages of every solution, and weighing and prioritizing alternatives to select the most promising one. Roleplays were used to problem-solve potential barriers to participants' target goals.

Session 6: Expanding the CBT "tool box" in pursuit of target goals.: Participants continued to build a "tool box" of resources to help them achieve their target goals in relation to meth use. The "A-B-C-D" method of problem-solving situations was introduced. This method involves talking back to yourself: A is the activating event; B is the belief or thought involved; C is the consequence and D is the way you dispute or talk back to the thought. The counselor used a coaching/teaching style to help participants apply the A-B-C-D method. Participants also reframed faulty interpretations. Eight types of faulty interpretations were discussed and applied to the participant's own life (e.g., labeling self, all-or-none thinking, emotional reasoning). Participants also learned about assertive communication skills in this session. Assertive communication in the context of meth use focused primarily on ways to deal with negative social influences.

Domain 3: Promoting Safer Sex

Session 7: The context of meth use and unsafe sex.: The primary goal of this session (and this third domain) was to help participants expand the skills from the six previous sessions and apply them toward safer sex practices. A range of motivators and personal triggers of

unsafe sex were explored (e.g., negative attitudes toward condoms, safe sex burnout). In addition, the counselor queried the participant as to what extent s/he perceived his/her sexual risk behaviors as a function of meth use. The counselor discussed the participant's desire and willingness to change his/her high risk sexual practices.

Session 8: Condom use.: The overall goal of this session was to promote consistent use of condoms by applying skills learned previously. Here the four parts of mood-to-action chain - thoughts, feelings, arousal and behavior—were reviewed in the context safer sex application. Social cognitive strategies, which include increasing knowledge, self-efficacy, and positive outcome expectancies in relation to condom use were utilized. Reasons for not using a condom were identified and a problem-solving approach was used to help the participant find ways to manage risky behavior. Roleplay exercises (including modeling and role reversal) were also used to help the participant rehearse sexual situations that were personally relevant.

Session 9: Negotiation of safer sex practices and enhancement of social supports.: The primary goal of this session was to increase participants' repertoires of safer sex practices, and to enhance negotiation and assertiveness skills through the use of cognitive and behavioral strategies. Building on previous sessions, problem-solving barriers to safer sex negotiation was placed in the context of teaching the participant steps in the negotiation process. The counselor and participant engaged in roleplay exercises, and together they reviewed successes and failures. The counselor also helped participants enhance positive social supports and minimize negative influences in relation to safer sex goals. As in earlier sessions, this was accomplished by problem-solving barriers to social support and helping participants to identify social network persons who would be supportive of safer sex goals. Participants were provided with information on strategies for managing negative influences (e.g., enhancing the participant's "power of persuasion" skills) and strategies for developing a new network of people who support safer sex goals.

Comparison/Education-only Condition

Participants in the comparison/education-only condition received nine hour-long educational counseling sessions. The condition was manualized and paralleled the intervention condition by having three domains (negative mood, meth usage, and sexual risk). All counselors were trained to deliver both the intervention and comparison protocols. The negative mood modules focused on education about symptoms of depression and included community resource information. The meth usage modules consisted of education materials about methamphetamine, education about 12-step approaches to substance abuse problems and information about health problems related to meth use. The sexual risk models comprised an overview of biological information about sexual transmitted infections (STIs) and its transmission including some educational information related to HIV/AIDS, and a list of available local resources.

Measures

Sociodemographics.—Participants reported their age, race (White, Black, Hispanic/Latino, Asian/Pacific Islander, American Indian, or Mixed Race/Other), country of birth

(U.S. vs other), marital status (married or common law marriage vs. single, never married or divorced), whether they resided with a spouse or steady partner (vs. not), whether they were homeless (vs. not), had children (vs. none), education (higher vs. less than a high school education), employment status (currently employed vs. not), income (annual income higher or less than \$10K), and whether they were ever convicted of a felony (vs. not).

Meth use.—In six separate items, participants were asked how often they snorted, smoked, injected, injected in combination with another drug, ate or drank, or used meth in any other way in the past two months. Response options were 0=never, 1=once in a while, 2=fairly often, and 3=very often. The items were summed to create a summary score of “frequency of meth use across different methods in the past two months.” Possible scores ranged from 0 to 18. Participants were also asked about their primary method of meth use.

Other substance use.—Participants were asked about their lifetime and past month use of heroin and cocaine in separate items. They also completed the ten-item AUDIT as a measure of hazardous alcohol use. A score of 8 or higher indicates hazardous drinking. (31,32).

Substance-related sexual risks.—In separate items, participants were asked whether they used alcohol, meth, or any other drug before or during sex in the past two months. They were also asked whether they traded sex for meth, and whether they have had sex in a public venue while high on meth, both in the past two months.

Injection-related risks.—Participants were asked whether they have injected with a borrowed needle and/or shared injection paraphernalia, both in the past two months.

Depression.—To measure depressive symptoms, participants were asked to complete the Beck Depression Inventory (BDI-II) scale. A total of 21 items assess depressive symptoms over the past two weeks (including today), and are summed to create a summary score ($\alpha = 0.91$). We used established cutoffs for minimal (0–13), mild (14–19), moderate (20–28), and severe depressive symptoms (29–63) (33).

Sexual risk behavior.—In separate open-ended items, participants reported their total number of vaginal and anal sex acts in the past two months, and how many times they (for men) or their partner (for women) used a condom for vaginal and anal sex. Items distinguished between insertive (for men) and receptive (for women) sex acts. We computed the total number of sex acts in the past two months, and the total number of condomless sex acts in the past two months.

Self-reported STI.—Participants indicated whether they had any of the following STIs in the past two months: gonorrhea, chlamydia, syphilis, genital or anal warts, genital or anal herpes, chancroid, Hepatitis B, Hepatitis C, Trichomoniasis, or any “other venereal disease or sexually transmitted disease or sores, discharges (in, on, or around the penis or anus) not listed previously.”

Data Analysis

Data were analyzed in stages. We examined descriptive statistics at baseline for sociodemographics, meth use, other substance use, depression, risk behavior, and STI. We examined statistics overall and tested for differences by condition and gender. We tested for group differences using chi-square tests for categorical variables and t-tests for continuous variables. We also conducted latent growth curve modeling (LGCM), a statistical method using structural equation modeling (i.e., of observed and latent variables) that allows for the estimation of inter-individual variability in intra-individual patterns of change, or growth, over time. The method has been used to examine changes over time in depression, meth use, and sexual risk behaviors among MSM (24). In intervention efficacy trials including multiple post-tests, both initial status (i.e., baseline) and change over the course of the study are modeled using latent variables for the “intercept” and the “slope,” respectively (34). Growth trajectories can be modeled in different ways, including linear and quadratic slopes. With parallel process growth models, changes in more than one variable or outcome can be modeled as separate, but co-occurring processes (35). As *Fastlane-II* was designed to simultaneously reduce depressive symptoms, meth use, and condomless sex, parallel process LGCM is an ideal method to examine intervention efficacy, changes over time, and moderation (36).

We used LGCM to estimate a single latent growth curve that included three parallel processes: one for depression (i.e., BDI score), methamphetamine use (i.e., frequency of meth use across different methods in the past two months), and condomless sex (total number of condomless sex acts in the past two months). For each variable of interest, we estimated a latent variable for the intercept factor, linear slope factor, and a quadratic slope factor, which describes any upturn or downturn over time beyond what is predicted by the linear slope factor. We then tested our hypothesis that there were differences between the two conditions in changes over time for depression, meth use, and condomless sex (i.e., efficacy) by regressing the three linear slope latent factors on condition. Finally, we tested our hypothesis that gender moderated intervention efficacy by regressing the intercept and linear slope latent factors of each of the three outcomes on condition, gender, and the condition by gender interaction. Details about any additional analyses are described in the results. Model fit was assessed by evaluating the Comparative Fit Index (CFI), Root Mean Squared Error Approximation (RMSEA) and the Standardized Root Mean Squared Residual (SRMR). We chose recommended cut off values of CFI = 0.95, RMSEA < 0.05, and SRMR = 0.08 to indicate good model fit (37).

Results

Sample characteristics

Sociodemographics.—Table 1 summarizes baseline descriptive statistics among the entire sample, by intervention condition, and by gender. Separated by condition and gender, a total of 85 men and 105 women were in the control condition, and 102 men and 80 women were in the intervention condition. The sample consisted of relatively equal numbers of men (51.6%) and women (48.4%). Mean age was around 38 years of age (SD = 10.1). A third of the participants were of Caucasian/White race (35.2%), and another third were of African-

American/Black race (33.8%). Most of the participants were born in the United States (93.3%). A small proportion (7.6%) were married or in a common-law marriage, although a quarter of participants reported residing with their spouse or steady partner (23.1%). Ten percent of the sample were homeless, a majority had at least one child (65.0%), a quarter completed less than a high school education (25.5%) and were currently employed (22.7%). A majority of the participants reported an annual income less than \$10,000 USD (70.1%) and reported being ever convicted of a felony (59.3%).

Meth use.—The mean frequency of meth use across different methods in the past two months was 4.2 (SD = 2.0).

Other substance use and substance-related risk behavior.—In terms of substance use apart from methamphetamine, a third reported lifetime use of heroin (32.4%), whereas three-quarters reported lifetime use of cocaine (73.6%). A small proportion used heroin in the past month (11.1%) and a quarter used cocaine in the past month (24.5%). Almost half of the sample screened positive for hazardous alcohol use (45.6%). Substance-related sexual risk behavior was reported, with almost all (93.8%) reporting using meth before or during sex, 63.9% using alcohol before or during sex, 53.9% reporting using a different drug before or during sex, 28.0% reporting trading sex for meth, and 41.9% reporting having sex in a public venue while high on meth, all in the past two months. Injected-related risk behavior was less common, with 12.5% reporting injecting with a borrowed needle and 17.4% sharing injection paraphernalia, both in the past two months.

Depression and sexual risk behavior.—In terms of depressive symptoms, 29.9% had minimal symptoms, 18.1% mild, 28.2% moderate, and 23.8% severe. In the past two months, average total number of sex acts was 56.6 (SD = 197.5), and average total of condomless sex acts was 48.1 (SD=194.7). One-fifth (20.1%) self-reported having an STI in the past 2 months.

Differences by intervention condition and by gender

A significantly greater proportion of married participants were allocated to the comparison condition (10.6%), compared to the Fastlane II condition (4.7%). The two conditions were equivalent to each other across all the other variables.

There were significant differences between women and men at baseline. Women were more likely than men to report being married (10.5% vs. 4.9%), homeless (14.4% vs. 6.3%), have children (72.2% vs. 58.3%), have an annual income less than \$10,000 (75.1% vs. 65.5%), and trade sex for meth in the past two months (32.5% vs. 23.8%). Women were also more likely than men to report smoking as their primary method of meth use (85.2% vs. 66.4%), and report severe depressive symptoms (31.1% vs. 17.0%). Men were more likely than women to report being convicted of a felony (68.0% vs. 50.2%), hazardous alcohol use (50.2% vs. 40.7%), and report using alcohol before or during sex in the past 2 months (70.0% vs. 57.4%). Although men reported a greater number of sex acts and condomless sex acts relative to women (Median = 25.0, IQR = 12–58.75 vs. Median = 20.0, IQR = 9–45,

and Median = 20.0, IQR = 6.25–54.75 vs. Median = 16.0, IQR = 7–39.5, respectively), women were more likely than men to report having a recent STI (27.8% vs. 13.0%).

Latent growth curve modeling

Parallel processes model.—We estimated a single latent growth curve model with 3 parallel processes for depression, methamphetamine use, and condomless sex. Table 2 summarizes the results from this parallel process model. The means for the intercept, linear slope, and quadratic slope latent factors were all statistically significant ($p < .001$). For the intercept factor, results showed that levels of depression, meth use, and condomless sex were significantly different from zero at baseline. For the linear slope factor, results showed that on average, depression, meth use, and condomless sex decreased from baseline to 12-month follow-up. For the quadratic slope factor, results showed that on average, there was a significant upturn in depression, meth use, and condomless sex beyond the decline showed by the linear slope factor. Figure 2 displays the trajectories from baseline through 12-month follow-up in the three outcome variables by intervention condition. We examined associations between the linear slope factors for the three variables. The slope of depression was significantly associated with the slope of meth use ($B = 8.61$, $p < .001$), but not with the slope of unprotected sex ($B = 90.49$, $p = 0.33$). The slope of meth use was significantly associated with the slope of unprotected sex ($B = 44.5$, $p = 0.01$). The model fit the data well ($\chi^2(36) = 69.83$, $p < .001$, $CFI = .96$, $RMSEA = .047$, $SRMR = .046$).

Main effect of intervention condition on changes over time.—Next, we tested intervention condition as a predictor of the three slope latent factors. Overall, on average there were no significant differences between the comparison condition and Fastlane II intervention condition in changes over time in depression ($b = -0.03$, $p = 0.95$), meth use ($b = -0.02$, $p = 0.81$), or condomless sex ($b = 0.44$, $p = 0.85$).

Gender moderating intervention efficacy.—We then tested our hypothesis that gender moderated intervention efficacy. We regressed the intercept and linear slope latent factors of each of the three outcomes on condition, gender, and the condition by gender interaction. This model fit the data well ($\chi^2(60) = 129.41$, $p < .001$, $CFI = .92$, $RMSEA = .052$, $SRMR = .054$). Results are displayed in Table 3. There were no significant effects on the intercept or linear slope latent factors for condomless sex. For the intercept latent factor for depression, there was a significant gender effect such that at baseline, men reported lower levels of depression than women. There were no significant effects on the linear slope factor for depression. For methamphetamine use, there was a significant effect of gender on the slope latent factor such that on average, men showed greater declines in meth use compared to women. There was also a significant condition by gender interaction on the slope latent factor for meth use.

We tested an equivalent model that controlled for potential confounding variables. Since women and men significantly differed at baseline on a number of characteristics (i.e., marital status, homelessness, having children, income, felony conviction, smoking is primary method of meth use, hazardous drinking, alcohol use during sex, trading sex for meth, and STI) that may account for the results, we included paths from these variables to the intercept

and linear slope latent factors for meth use. Even after controlling for these variables, the interaction effect between condition and gender on the linear slope factor for meth use remained statistically significant ($B = -0.42$, $t = -2.31$, $p = 0.02$).

Post-hoc analyses

We conducted stratified analyses between women and men to probe the condition by gender interaction. Specifically, we tested the effect of condition on the linear slope latent factor for methamphetamine use separately for women and for men. Figure 3 displays the trajectories from baseline to 12-month follow-up in meth use by condition, separately for women and for men.

Women only.—Among women, condition did not significantly affect changes in meth use over time ($b = 0.13$, $p = 0.16$).

Men only.—Among men, there was a significant effect of condition on changes in meth use over time ($b = -0.32$, $p = 0.01$), indicating that men in the Fastlane II intervention condition showed greater decreases in meth use compared to men in the comparison condition. In the same model, we also found that among men, decreases in meth use were significantly correlated with decreases in condomless sex ($b = 5.27$, $p = 0.01$), but not with decreases in depression scores ($b = 0.20$, $p = 0.43$). We also found a marginal trend such that the upturn in meth use appeared to differ by condition ($b = -0.09$, $p = 0.06$), with those men in the Fastlane II intervention showing less of an upturn in meth use at 8- and 12-month follow-up compared to men in the comparison condition.

Discussion

Individuals who use meth are at an increased risk for HIV and other STIs. Apart from the association between meth use and risky sexual behavior, research has also demonstrated the co-occurrence of meth use with depression. The overall goal of the current paper was to evaluate the efficacy of *Fastlane-II*, a tri-focal behavioral intervention designed to reduce depressive symptoms, meth use, and condomless sex among meth-using heterosexual women and men. Another aim of the paper was to test whether women and men differed in their response to the intervention, in other words whether gender moderated efficacy. Using LGCM techniques, we found that the intervention and comparison groups did not differ in changes over time in depression, meth use, or condomless sex. We did find that gender moderated efficacy with respect to meth use, such that among men, those randomized into the *Fastlane-II* intervention exhibited greater reductions in meth use compared to those in the comparison condition. Reductions in meth use among men was associated with concomitant reductions in condomless sex, but not depression. Among women, there were no differences in changes over time in any of the three outcomes between the two conditions.

Analysis using LGCM revealed that participants in both the intervention and comparison conditions exhibited improvements in health outcomes over the course of the study, including reductions in depressive symptoms, meth use, and condomless sex. Previous studies in the area of health research have found similar patterns of improvements among control group participants (38). While one reason may be measurement reactivity, a type of

Hawthorne effect in which the mere act of completing measures can lead to changes in the behaviors being measured (39), one would assume that educational conversations between a client and the counselor on topics related to the study's outcomes would only enhance the possible Hawthorne effect. This effect may be especially pronounced among vulnerable populations like the one studied here. A majority of the participants reported a low annual income (i.e., less than \$10,000, a history of incarceration (i.e., being convicted of a felony), and were currently experiencing moderate to severe depression. Counselors for both the intervention and comparison groups may have been perceived as a source of social support. Indeed, all participants completed nine sessions with their counselor during which the counselor exhibited obvious and explicit interest in the participant's health and well-being. In sum, the current efficacy trial employed rigorous standards by including an education-only comparison group, which may have led to the lack of difference between arms.

In spite of the rigor, we were able to demonstrate efficacy at reducing meth use among men, which was related to reductions in condomless sex (but not depression). Unlike men, the health outcomes of women did not benefit from the intervention. In this study, women were more likely than men to be homeless, have dependent children, have a lower income, have more moderate and severe depression, and trade sex for meth. Although this was not measured, women may have also been more likely than men to trade sex for money or shelter. Thus, the women in this study appeared to experience greater social and structural vulnerabilities, and perhaps needed greater or different intervention attention compared to the men.

Previous research with women who use meth conducted by Lorvick (17) has demonstrated that women do not often concern themselves with the sexual risks involved when using meth. Instead, they emphasize how meth increases their sexual desire, allowing them to experience more intense and prolonged sexual activity. They also describe more sexual pleasure while on meth, with some describing how achieving orgasm was only possible while on meth. Finally, women describe how meth allows them to feel uninhibited, empowered, and agentic. While these experiences can also be found among men who use meth, the experience likely differs when one considers how women are generally stereotyped, treated as, and are expected to be sexually submissive, lacking desire and agency in sex compared to men (40–43). In order to effectively reduce meth use among women, interventions must recognize women's desire or need to maintain the pleasure, empowerment, and agency they feel when using meth that they may not otherwise experience.

Not addressed and therefore a limitation of the current study - women also experience a more unique vulnerability to intimate partner violence compared to men. Although both women and men can experience violence as both perpetrators and targets, violence against women poses increased and exacerbated risks for HIV (44,45). In addition, compared to men, heterosexual women are also more likely to experience co-morbid substance use, violence, depression, and sexual risks (46). Women who use meth are more likely to experience violence while high or during withdrawal (47). Gender-specific interventions targeting meth use and/or HIV risk behavior should take into account the role of violence (48). Another limitation of the study that is worth noting is that the findings are limited to a

two-month recall period, thus failing to capture the totality of behaviors in the four months between assessments.

Researchers have argued that HIV prevention interventions for substance-using women must take into account the individual and environmental factors that promote both substance use and HIV risk behavior for women. These factors include gendered power dynamics within heterosexual partnerships, sex work, and criminalization (49). While taking such factors into account, interventions can also be developed that employ female-initiated prevention methods. In a qualitative study of women with a history of methamphetamine use and partner violence (50), women were not interested in using female condoms, but were interested in vaginal microbicides. The latter was viewed as convenient, and also offered a sense of control and empowerment. Future research should examine whether other biomedical HIV prevention strategies, including pre-exposure prophylaxis, or PrEP, are feasible and acceptable to use among women who use meth. Overall, the current research helps to point to the different needs of heterosexual women and men when reducing HIV risks, depression, and meth use.

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Figure 1.
Diagram summarizing participant flow through the study.

Figure 2. Growth (change) trajectories from baseline through 12-month follow-up in the three outcome variables by intervention condition.

Figure 3.
Growth (change) trajectories from baseline to 12-month follow-up in methamphetamine use by condition, separately for women and for men.

Table 1.
Descriptive statistics of Fastlane II participants by intervention condition and by gender at baseline (n=432)

Variable	Total (n=432)		Comparison Condition (n=218)		Fastlane II Intervention (n=214)		p*	Women (n=209)		Men (n=223)		p*
	n	%	n	%	n	%		n	%	n	%	
Sociodemographics												
Gender							0.50					-
Male	223	51.6%	110	50.5%	113	52.8%		-	-	-	-	
Female	209	48.4%	110	50.5%	99	46.3%		-	-	-	-	
Age (years) (Mean, SD)	37.8	10.1	37.6	10.1	38.1	10.0	0.58	36.4	9.2	39.2	10.7	.003
Race							0.38					0.36
White	152	35.2%	86	39.4%	66	30.8%		77	36.8%	73	32.7%	
Hispanic/Latino	86	19.9%	40	18.3%	46	21.5%		44	21.1%	39	17.5%	
Black	146	33.8%	73	33.5%	73	34.1%		56	26.8%	78	35.0%	
Asian/Pacific Islander	9	2.1%	5	2.3%	4	1.9%		5	2.4%	4	1.8%	
American Indian	5	1.2%	1	0.5%	4	1.9%		1	0.5%	4	1.8%	
Mixed Race/Other	19	4.4%	15	6.9%	19	8.9%		26	12.4%	25	11.2%	
US-born	403	93.3%	202	92.7%	201	93.9%	0.25	193	92.3%	210	94.2%	0.57
Married	33	7.6%	23	10.6%	10	4.7%	0.03	22	10.5%	11	4.9%	0.03
Resides with spouse or steady partner	100	23.1%	55	25.2%	45	21.0%	0.36	42	20.1%	58	26.0%	0.17
Homeless	44	10.2%	20	9.2%	24	11.2%	0.53	30	14.4%	14	6.3%	0.007
Has children	281	65.0%	136	62.4%	145	67.8%	0.16	151	72.2%	130	58.3%	0.002
Less than a high school education	110	25.5%	55	25.2%	55	25.7%	0.83	60	28.7%	50	22.4%	0.15
Employed	98	22.7%	52	23.9%	46	21.5%	0.65	42	20.1%	56	25.1%	0.25
Annual income less than \$10K	303	70.1%	153	70.2%	150	70.1%	0.83	157	75.1%	146	65.5%	0.04
Ever convicted of a felony	256	59.3%	132	60.6%	124	57.9%	0.85	105	50.2%	151	68.0%	<.001
Meth Use												
Frequency of meth use across different methods in past 2 mo. (Mean, SD) Primary method of meth use	4.2	2.0	4.1	2.1	4.3	2.0	.31	4.2	1.9	4.2	2.1	0.80
Snort	58	13.4%	21	9.6%	37	17.3%		11	5.3%	47	21.1%	
Smoke	326	75.5%	173	79.4%	153	71.5%		178	85.2%	148	66.4%	
Inject	41	9.5%	21	9.6%	20	9.3%		18	8.6%	23	10.3%	

Variable	Total (n=432)		Comparison Condition (n=218)		Fastlane II Intervention (n=214)		p*		Women (n=209)		Men (n=223)		p*
	n	%	n	%	n	%	n	%	n	%	n	%	
Eat or drink	4	0.9%	3	1.4%	1	0.5%	1	0.5%	3	1.3%			
Other	3	0.7%	0	0.0%	3	1.4%	1	0.5%	2	0.9%			
Smoking as primary method of meth use	326	75.7%	173	79.4%	153	71.5%			178	85.2%	148	66.4%	<.001
Other Substance Use													
Ever used heroin	140	32.4%	73	33.5%	67	31.3%			62	29.7%	78	35.0%	0.26
Ever used cocaine	318	73.6%	154	70.6%	164	76.6%			147	70.3%	171	76.7%	0.16
Used heroin in past month	48	11.1%	24	11.0%	24	11.2%			22	10.5%	26	11.7%	0.76
Used cocaine in past month	106	24.5%	52	23.9%	54	25.2%			45	21.5%	61	27.4%	0.18
Hazardous drinker (8 on AUDIT)	197	45.6%	96	44.0%	101	47.2%			85	40.7%	112	50.2%	0.05
Substance-related Sexual Risks													
Used alcohol before or during sex in past 2 months	276	63.9%	136	62.4%	140	65.4%			120	57.4%	156	70.0%	0.007
Used meth before or during sex in past 2 months	405	93.8%	208	95.4%	197	92.1%			194	92.8%	211	94.6%	0.55
Used other drug before or during sex in past 2 months	233	53.9%	118	54.1%	115	53.7%			116	55.5%	117	52.5%	0.56
Traded sex for meth in past 2 months	121	28.0%	66	30.3%	55	25.7%			68	32.5%	53	23.8%	0.05
Had sex in a public venue when high on meth in past 2 months	181	41.9%	83	38.1%	98	45.8%			84	40.2%	97	43.5%	0.50
Injection-related Risks													
Injected with a borrowed needle in past 2 months	54	12.5%	22	10.1%	32	15.0%		0.0%	27	12.9%	27	12.7%	0.88
Shared injection paraphernalia in past 2 months	75	17.4%	36	16.5%	39	18.2%			38	18.2%	37	16.6%	0.70
Depression (BDI-II)													
Minimal	129	29.9%	69	31.7%	60	28.0%			45	21.5%	84	37.7%	<.001
Mild	78	18.1%	39	17.9%	39	18.2%			34	16.3%	44	19.7%	
Moderate	122	28.2%	62	28.4%	60	28.0%			65	31.1%	57	25.6%	
Severe	103	23.8%	50	22.9%	53	24.8%			65	31.1%	38	17.0%	
Sexual risk behavior													
Total number of sex acts in past 2 mo (Median, IQR)	22.0	10–50	22.0	8–50	23.0	11–54			20.0	9–45	25.0	12–58.75	0.012
Total condomless sex acts past 2 mo (Median, IQR)	19.0	7–45.5	19.0	6–44.5	18.0	8–49			16.0	7–39.5	20.0	6.25–54.75	0.008
Self-reported STI in past 2 mo	87	20.1%	41	18.8%	46	21.5%			58	27.8%	29	13.0%	<.001

* Notes: Chi-square tests for categorical variables and t-tests for continuous variables

Table 2.

Latent growth curve model results including three parallel processes for depression, meth use, and condomless sex among heterosexual men and women (n=432).

	Means			Variances		
	M	t	p	D	t	p
Intercept Latent Factor						
Depression	20.13	35.16	< .001	38.91	1.77	0.08
Methamphetamine Use	4.15	43.56	< .001	-0.42	-0.49	0.63
Condomless Sex	70.10	15.36	< .001	1101.34	0.88	0.38
Linear Slope Latent Factor						
Depression	-7.39	-9.73	< .001	9.13	0.29	0.77
Methamphetamine Use	-1.56	-9.78	< .001	-1.70	-1.29	0.20
Condomless Sex	-44.45	-7.43	< .001	386.36	0.20	0.84
Quadratic Slope Latent Factor						
Depression	1.58	6.90	< .001	1.39	0.58	0.57
Methamphetamine Use	0.40	7.23	< .001	0.03	0.27	0.79
Condomless Sex	11.68	6.62	< .001	161.92	1.14	0.26

Table 3.

Latent growth curve modeling results of condition, gender, and the condition by gender interaction effects on the intercept and slope latent factors for depression, meth use, and condomless sex (n=432).

Independent Variable:	Condition			Gender			Condition X Gender Interaction		
	B	t	p	B	t	p	B	t	p
<i>Intercept Latent Factor</i>									
Depression	-0.57	-0.39	0.70	-5.41	-3.78	<.001	0.24	0.12	0.91
Methamphetamine Use	-0.05	-0.18	0.86	-0.32	-1.21	0.22	0.32	0.84	0.40
Condomless Sex	-8.20	-0.97	0.33	4.85	0.58	0.56	7.68	0.64	0.52
<i>Linear Slope Latent Factor</i>									
Depression	-0.15	-0.28	0.82	0.24	0.37	0.71	0.60	0.66	0.51
Methamphetamine Use	0.17	1.27	0.20	0.39	2.88	0.004	-0.49	-2.58	0.01
Condomless Sex	2.65	0.66	0.51	4.93	1.25	0.21	-3.17	-0.57	0.57