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Age differences in outcomes among patients in the “Stimulant Abusers Groups to Engage in 12-Step” (STAGE-12) Intervention

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Abstract

Emerging adults (roughly 18–29 yrs.) with substance use disorders can benefit from participation in twelve-step mutual-help organizations (TSMHO), however their attendance and participation in such groups is relatively low. Twelve-step facilitation therapies, such as the Stimulant Abuser Groups to Engage in 12-Step (STAGE-12), may increase attendance and involvement, and lead to decreased substance use.

Aims—Analyses examined whether age moderated the STAGE-12 effects on substance use and TSMHO meeting attendance and participation.

Design—We utilized data from a multisite randomized controlled trial, with assessments at baseline, mid-treatment (week 4), end-of-treatment (week 8), and 3- and 6- months post-randomization.

Participants—Participants were adults with DSM-IV diagnosed stimulant abuse or dependence (N=450) enrolling in 10 intensive outpatient substance use treatment programs across the U.S.

Analysis—A zero-inflated negative binomial random-effects regression model was utilized to examine age-by-treatment interactions on substance use and meeting attendance and involvement.

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Conflicts of Interest: None

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Findings—Younger age was associated with larger treatment effects for stimulant use. Specifically, younger age was associated with greater odds of remaining abstinent from stimulants in STAGE-12 versus Treatment-as-Usual; however, among those who were not abstinent during treatment, younger age was related to greater rates of stimulant use at follow-up for those in STAGE-12 compared to TAU. There was no main effect of age on stimulant use. Younger age was also related to somewhat greater active involvement in different types of TSMHO activities among those in STAGE-12 versus TAU. There were no age-by-treatment interactions for other types of substance use or for treatment attendance, however, in contrast to stimulant use; younger age was associated with lower odds of abstinence from non-stimulant drugs at follow-up, regardless of treatment condition. These results suggest that STAGE-12 can be beneficial for some emerging adults with stimulant use disorder, and ongoing assessment of continued use is of particular importance.

Keywords

twelve-step facilitation; mutual-help; self-help; stimulant use; emerging adults

1. Introduction

Emerging adulthood, the period roughly between 18 and 29 years of age, has been characterized as being a unique developmental period as compared to both adolescence and adulthood in more developed, western cultures. Emerging adulthood is described as a time of personal exploration with reduced societal and family restrictions along with fewer responsibilities and more social/personal instability (Arnett, 2000, 2005). This age group also has a higher prevalence of substance use and related substance use disorders than those either younger or older (Substance Abuse and Mental Health Services Administration, 2015).

While emerging adults face an increased risk for substance use disorders, the literature has outlined some specific challenges in providing services to this population. Older age has been associated with a greater readiness to change (Sinha, Easton, & Kemp, 2003), higher rates of treatment completion (Hser, Joshi, Maglione, Chou, & Anglin, 2001; Korte, Rosa, Wakim, & Perl, 2011; Maglione, Chao, & Anglin, 2000; Satre, Mertens, Arean, & Weisner, 2003), and better treatment outcomes (Oslin, Pettinati, & Volpicelli, 2002; Satre, Chi, & Mertens, 2012; Satre, et al., 2003). Specifically, Oslin et al. (2002) found that older participants were more likely to attend regular treatment visits (85.0% vs. 64.1%, $p < .01$) and adhere to medication for the treatment of alcohol use disorder (80.0% vs. 55.3%, $p < .05$) at three-months than were younger participants. Satre and colleagues (Satre, et al., 2012; Satre, et al., 2003) examined treatment retention six-months following intake into alcohol and drug treatment, as well as alcohol and other drug use at six-months and five, seven, and nine years post-intake. While there were no age differences in treatment initiation, older and middle aged adults stayed significantly longer in treatment than did adults age 39 or younger ($p < .001$). They further found that at most follow-up points, older and middle-aged adults were more likely to have abstained from alcohol and other drugs within the prior year than were younger adults.

Other studies have found that younger adults are less likely to perceive a need for treatment (Sinha, et al., 2003; Wu & Ringwalt, 2004), to enter treatment following detoxification (Shin, Lundgren, & Chassler, 2007), and to comply with recommendations for treatment (Aalto & Sillanaukee, 2000). Potential reasons why younger adults have less success with traditional treatment have been described by Bergman and colleagues (2016) and include: 1) lower initial motivation for treatment engagement and abstinence, 2) social networks composed of others with high rates of substance use, 3) higher rates of co-occurring psychiatric disorders, 4) lower levels of conscientiousness (e.g. ability to make it to scheduled meetings and appointments), and 5) feeling “in-between”, meaning that emerging adults have more freedom and independence than adolescents, but often greater dependence on parents or other caregivers than do older adults.

Community-based twelve-step mutual-help organizations (TSMHOs) are the most commonly utilized form of support for people attempting to change their substance use and are used both independently and in conjunction with more formal treatment (Substance Abuse and Mental Health Services Administration, 2012). There is evidence that attendance and active involvement in Alcoholics Anonymous (AA) or Narcotics Anonymous (NA), particularly as a follow-up to more traditional treatment programs, can result in higher rates of abstinence among emerging adults (Bergman, Greene, Hoepfner, Slaymaker, & Kelly, 2014; Bergman, Hoepfner, Nelson, Slaymaker, & Kelly, 2015; Hoepfner, Hoepfner, & Kelly, 2014; Kelly, Stout, & Slaymaker, 2012, 2013). Hoepfner, et al. (2014) examined data from Project MATCH, a large clinical evaluation of three treatments for disordered alcohol use, to identify similarities and differences in mediators of AA between younger (18–29) and older (30+) adults. For younger adults, two of six mediational pathways were significant, compared to six complete pathways for adults. The two strongest mediators for young adults were increased self-efficacy in social situations and a decrease in pro-drinking social networks, and both pathways were more salient for younger than for older adults. Notably TSMHO meetings benefitted younger adults as much as older adults, despite fewer mediational pathways. The authors suggest that pathways as yet unidentified may exist for younger adults. Other research has found the TSF is more effective with people who have social networks supportive of drinking, as is often the case for emerging adults, than is Motivation Enhancement Therapy or Cognitive Behavioral Therapy (Longabaugh, Wirtz, Zweben, & Stout, 1998; Wu & Witkiewitz, 2008).

Another prospective study of attendance and involvement in TSMHOs following treatment (Kelly, et al., 2013) showed that emerging adults can be motivated to attend and become active in TSMHOs, and that those who do demonstrate greater abstinence. In this study, about a third of the sample had attended at least one TSMHO meeting in the 90 days prior to entering treatment. This rate increased to 90% at three-months following treatment, tapering to about 76% a year after treatment. Frequency of attendance was 2–3 times per month prior to treatment, and rose substantially to an average of 3–4 times *per week* at three months and 1–2 times *per week* one year after treatment. Importantly, both attendance and active involvement in TSMHOs were independently associated with an increase in percent of days abstinent and a decrease in days of heavy drinking.

However, despite the benefits, emerging adults appear to be more difficult to engage in TSMHOs than are older adults. One study looking at predictors of retention in dual-focus TSMHOs (substance use and psychiatric comorbidity; Laudet, Magura, Cleveland, Vogel, & Knight, 2003) and another examining factors associated with frequency of meeting attendance (Brown, O'Grady, Farrell, Flechner, & Nurco, 2001) found that younger adults were less likely to utilize community TSMHOs than were older adults, demonstrated by lower frequency of meeting attendance after four months (Brown, et al., 2001), and one-year (Laudet, et al., 2003) following entrance into outpatient treatment.

“Stimulant Abuser Groups to Engage in 12-Step” (STAGE-12; Baker, Daley, Donovan, & Floyd, 2007; Donovan et al., 2013) is a manualized combined group and individual Twelve-Step Facilitation (TSF) treatment designed to help individuals with stimulant abuse or dependence overcome perceived barriers to TSMHO attendance and enhance engagement in 12-step recovery. As such, it may be particularly well suited for younger people who have historically had more difficulty in engaging in such groups, but for whom there is evidence that participation would be beneficial. Group sessions focus on increasing attendance and participation in meetings through five topic areas: 1) acceptance (Step 1); 2) people, places, and things (habits, routines, and relapse triggers); 3) surrender (Steps 2 and 3); 4) getting active in 12-step programs; and 5) managing negative emotions (HALT: hungry, angry, lonely, tired). An explicit focus on people and routines may be particularly important to emerging adults who are more likely to have social networks comprised of people actively engaged in substance use (Bergman, et al., 2016). In addition, STAGE-12 incorporates an intensive referral procedure (Timko & DeBenedetti, 2007) that actively connects participants with a 12-step volunteer in the community who arranges to attend a meeting with them. This additional support from an experienced adult may be beneficial in increasing conscientious meeting attendance among young adults who are more likely to be new to TSMHO culture and concepts.

In contrast, Davis and colleagues (Davis, Bergman, Smith, & Kelly, 2017) surmised that TSF therapies may be a mismatch for emerging adults compared to other therapies, such as Cognitive-Behavioral Therapy, due to lower dependence severity and initial abstinence motivation often associated with younger age. In a secondary analysis of data from Project MATCH (Project MATCH Research Group, 1998), they found that, in fact, emerging adults assigned to TSF had a lower percentage of days abstinent and greater number of drinks per drinking day during the 12-week treatment than emerging adults assigned to either Cognitive Behavioral Therapy or Motivational Enhancement Therapy, and to older adults in any treatment condition. There were no differences in alcohol outcomes by emerging adult status and treatment condition by the one-year follow-up.

The analyses described here builds on this work by utilizing a different dataset collected in a National Drug Abuse Treatment Clinical Trials Network multi-site study that evaluated a group-plus-individual TSF intervention for stimulant users. STAGE-12 had the goal of increasing attendance and participation in TSMHO and ultimately reducing stimulant and other drug use (Donovan, et al., 2013). Analyses of self-reported substance use revealed that STAGE-12 led to increased abstinence from stimulant and other drug use during active treatment, as well as increased TSMHO meeting attendance and involvement through a six-

month follow-up period, among those who are able to achieve abstinence at all. However, among people who did not remain abstinent during treatment, those in the STAGE-12 group had somewhat higher rates of substance use compared to those in TAU. Of particular importance is that age was not a predictor of treatment completion for those randomized to receive STAGE-12 (Doyle & Donovan, 2014). Treatment completion is a consistent predictor of better treatment outcomes (McLellan, 2006; Simpson, Joe, Rowan-Szal, & Greener, 1997). The fact that younger participants were as likely as older participants to complete the STAGE-12 treatment could suggest that younger adults in STAGE-12 may be able to achieve outcomes similar to their older counterparts, who are often found to fare better in treatment.

The primary aim of this paper was to examine baseline age differences, and whether age moderated the STAGE-12 effects on stimulant use, non-stimulant use, TSMHO meeting attendance, and active involvement. We hypothesized that emerging adults will have initially lower motivation to attend and engage in TSMHO meetings, but that assignment to STAGE-12 will result in outcomes more similar to those of older adults, compared to those assigned to treatment-as-usual (TAU).

2. Methods

2.1 Design

The current examination uses data from a larger, parent study: a two-group randomized repeated measures design comparing TAU to TAU integrated with STAGE-12 (Donovan, et al., 2013). Assessments occurred at baseline, week 4 (mid-treatment), week 8 (end of treatment), and 3- and 6-months post-randomization. All study procedures were approved by the Institutional Review Board (IRB) at the University of Washington and the IRBs affiliated with each study site. A Data and Safety Monitoring Board was convened by the National Institute on Drug Abuse (NIDA) to review study design and monitor data and safety along with protocol compliance throughout the trial.

2.2 Participants

Participants were adults (18 years of age or older) recently enrolled in intensive outpatient treatment at one of ten participating community treatment programs (CTPs) in the United States who met the following criteria: 1) used stimulant drugs within the 60 days prior to enrollment (or in the past 90 days if incarcerated during the prior 60 days); 2) met current (past six months) *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) diagnosis for abuse or dependence for a stimulant; 3) were able to provide consent; and 4) indicated a willingness to provide information about substance use, be randomly assigned to a treatment condition, and be audio-recorded during the treatment sessions. People were excluded if they: 1) required detoxification for opioid withdrawal; 2) were seeking detoxification only, medication assisted treatment, or residential/inpatient treatment; 3) had a medical or psychiatric condition that would make study participation hazardous; 4) were incarcerated for more than 60 days of the prior 90 days; or 5) had pending legal actions that could impede completion of the study. As reported elsewhere,

71.8% of the sample met DSM-IV dependence criteria for cocaine use, 36.1% for methamphetamine use, and 6.8% for amphetamine use (Donovan et al., 2013).

2.3 Treatment conditions

Participants were randomized to TAU or TAU plus STAGE-12 within the CTP in which they were enrolled. TAU varied somewhat across sites, but all sites offered 5–15 hours of psychosocial intensive outpatient care per week involving both group and individual counseling. While some CTPs encouraged clients to attend TSMHO meetings in the community as part of TAU, none of the CTPs provided a systematic TSF intervention, such as STAGE-12.

In the intervention group, the manualized STAGE-12 intervention replaced five group and three individual sessions of TAU over an eight-week period. The STAGE-12 group sessions focused on explaining 12-step philosophy, specifically addressing common misconceptions or perceived barriers to participation. The individual sessions involved an intensive referral procedure (Timko & DeBenedetti, 2007; Timko, DeBenedetti, & Billow, 2006) that emphasized active participation in 12-step activities and the introduction of a 12-step volunteer from the community who would accompany the participant to at least one meeting. A more detailed description of the STAGE-12 intervention can be found elsewhere (Baker, et al., 2007; Daley, Baker, Donovan, Hodgkins, & Perl, 2011; Donovan, et al., 2013).

2.4 Measures

2.4.1 Demographics—Participants were asked to report their date of birth, sex (male or female), ethnicity, and race. Age was calculated from date of birth. The definition of “emerging adulthood” has varied from publication to publication, and has been defined variously as 18–25, 18–29, and even 18–39 (Bergman, et al., 2016). Although an age grouping binary variable may be appropriate in some studies (Davis, et al., 2017; Hoepfner, et al., 2014), the analysis of age as a continuous variable allows for the assessment of the treatment effect interacting with EACH age year, and is not restricted to a pre-defined group of young vs. older, and therefore was not dichotomized for these analyses. This allows an easier examination of the transition to adulthood.

2.4.2 Lifetime substance use—Baseline information on lifetime use (number of years) of stimulants and non-stimulants was obtained from the Addiction Severity Index (ASI) - Lite (McLellan, Alterman, Cacciola, Metzger, & O'Brien, 1992). The maximum number of years of any stimulant use included amphetamines, methamphetamines, and cocaine. The maximum number of years of non-stimulant use included the use of alcohol, heroin, methadone, other opioids/analgesics, other sedatives/hypnotics/tranquilizers, and cannabis. Primary drug was identified on the DSM-IV Criteria Checklist interview (Hudziak et al., 1993).

2.4.3 Substance use outcomes—Substance use outcome measures were the number of days of self-reported drug or alcohol use within a 30-day window of assessment across a 6-month post-randomization period as assessed by the Substance Use Calendar (SUC), a calendar-based method comparable to the timeline followback procedure (Fals-Stewart,

O'Farrell, Freitas, McFarlin, & Rutigliano, 2000; Sobell & Sobell, 1992). The primary outcome variable was the number of days of stimulant drug use, which included methamphetamine, amphetamine, cocaine, and other stimulants. A secondary outcome was the number of days of non-stimulant use (i.e., alcohol, cannabis, opioids, and benzodiazepines).

2.4.4 TSMHO history—"Mutual-help" in these analyses, included only meetings that use the 12-step model. Past involvement with community TSMHO meetings was a single question in the 12-Step Experiences and Expectations questionnaire and was developed for use in this study: "Have you ever been involved in any kind of self-help groups for alcohol/drug problems in the past?" If, yes, participants were asked to identify the type of meeting(s) attended (e.g. Alcoholics Anonymous or Cocaine Anonymous).

2.4.5 TSMHO meeting attendance—Attendance at TSMHO meetings was measured with the Self-Help Activities Questionnaire (SHAQ; Weiss et al., 1996). The study measure assessed the number of days in the preceding 30-day period of attendance at AA, NA, Cocaine Anonymous (CA), or Crystal Meth Anonymous (CMA). Attendance was measured at baseline, week 4, week 8, and three-, and six-months post-randomization.

2.4.5 TSMHO active involvement—The number of types of TSMHO activities beyond attendance was also measured by the SHAQ. This outcome variable ranges in value from 0 to 6 and indicates within a 30-day window of assessment whether the participant had at least once (a) met with one or more AA/NA/CA/CMA members outside a meeting, (b) met with their sponsor(s) outside a meeting, (c) phoned their AA/NA/CA/CMA sponsor(s), (d) received at least one phone call from their sponsor(s), (e) received at least one phone call from other AA/NA/CA/CMA members, or (f) read AA/NA/CA/CMA literature for at least 5 minutes. The number of different types of TSMHO activities was measured at baseline, week 4, week 8, and three-, and six-month post-randomization.

2.4.6 Ambivalence and readiness to engage in mutual-help activities—The Survey of Readiness for Alcoholics Anonymous Participation (SYRAAP) is a validated, brief self-administered 15-item measure that assesses ambivalence and readiness to engage in any AA/NA/CA/CMA 12-step activities (Kingree, Simpson, Thompson, McCrady, & Tonigan, 2007; Kingree et al., 2006). The SYRAAP consists of three subscales related to the perceived severity of the respondents' substance use and perceived benefits and perceived barriers to participating in AA, NA, CA or CMA activities. In this study, the SYRAAP was administered at baseline and 8-weeks follow-up.

2.5 Analysis

Analysis of Variance (ANOVA) and Pearson correlations were used to identify baseline age differences by sex, ethnicity, race, primary drug, years of use, prior TSMHO history, and readiness to engage in 12-step activities.

In each model described below, age was included as an independent continuous variable. The outcome variables were: 1) days of self-reported stimulant use, 2) days of other drug use, 3) days of TSMHO meeting attendance, and 4) the number of different TSMHO

activities. All models controlled for the treatment, time, and treatment-by-time effects and initially included the variables of race (Caucasian vs. minority ethnic group) and sex. If race and sex were found to be statistically significant covariates ($p < .05$), they remained in the model. If they were not significant, they were removed, as they added nothing to the model and better convergence was achieved without them. The age-by-treatment interaction was examined to answer the question of whether age moderated the effects of the STAGE-12 intervention.

The SUC substance use outcomes (number of days of self-reported stimulant use or number of days of non-stimulant use within a 30-day window across 6 months) were count data. Given the excess of zeros and over-dispersion with the SUC measures of stimulant and non-stimulant use, a zero-inflated negative binomial random-effects regression model was utilized. This mixture model included two components: a) a logistic part to account for zero-inflation (days of abstinence) which produces odds ratios (ORs) and b) a negative binomial part to assess rate of use, represented by rate ratios (RRs). In other words, the logistic part (ORs) addresses whether or not participants used, while the negative binomial part (RRs) addresses how much they used, if they did use. The rate ratio (RR) can be viewed as a relative measure of two rates, one rate for those in STAGE-12 divided by those in TAU. For example, $RR = 1.0$ indicates no difference in rates of stimulant use; whereas $RR = 1.9$ indicates that those in STAGE-12 had a 90 percent increase in rate of use than those in TAU. The maximum percent of observed zeros across the 6 post-randomization time points of measurement was 76.3% and 71.5% for stimulant and non-stimulant use, respectively. To examine the moderating effects of age on treatment, the age-by-treatment interaction was assessed, and as with the main effects included the two components described above; a logistic part indicating days of abstinence (ORs) and the rate of use or count component (RRs). The evaluation of the statistical significance of the age-by-treatment interaction effect with the zero-inflated and regular negative binomial regression models was conducted with algorithms for the ORs or RRs provided by Hilbe (2008, 2011). With this model, there are as many interaction effects as there are values of the continuous age predictor, with the statistical significance ($p = .05$) determined if the confidence interval does not include the value of 1.0. All models controlled for the treatment, time, and treatment-by-time effects and included the variables of race (Caucasian vs. minority ethnic group) and sex if they were found to be statistically significant covariates ($p < .05$). Pre-treatment covariates were calculated as the average number of days of stimulant or non-stimulant use within 30-day windows of assessment: 60+ to 90 days pre-randomization, 30+ to 60 days pre-randomization, and the 30 days prior to treatment randomization.

To evaluate the potential for the age variable to be a proxy or surrogate for length of substance use, a sensitivity analysis was conducted; variables from the ASI-Lite were used to assess self-reported maximum number of years of stimulant or non-stimulant use and substituted for the age variable as the main predictor in the negative binomial regression models described above.

The two outcomes from the SHAQ are the number of days in the preceding 30-day period of attendance at either an AA, NA, CA or CMA meeting, and the number of different types of activities beyond attendance within a 30-day window. To assess attendance at and number of

types of activities, with count data not zero-inflated, a regular negative binomial random-effects regression model was utilized. Unlike the zero-inflated models, only a rate ratio is generated. The number of days of attendance or types of activities within a 30-day window of assessment at each of the five time points (baseline, week 4, week 8, and three-, and six-month post-randomization) was included in each model. Similar to the zero-inflated models, the treatment, time, and treatment-by-time effects were controlled for and the variables of race (Caucasian vs. minority ethnic group) and sex were included if they were found to be statistically significant covariates ($p < .05$).

If the interaction effect was not statistically significant, the main effect of age on the outcome was considered. Although data were obtained from multi-sites, given the complexity of the regression models utilized, inclusion of site would not allow for viable solutions. Statistical results for the negative binomial random-effects regression models were obtained with the SAS software (Copyright ©2010) and estimated with the NLMIXED procedure.

3. Results

3.1 Baseline age differences

Of the original 450 participants, there were $n = 421$ with complete SUC data and $n = 427$ with SHAQ data at a minimum of one follow-up point, and thus were included in one or more of the below analyses of age differences in treatment outcomes, and in the analysis of baseline age differences. The mean age of study participants was 38.4 years ($sd=9.8$), with ages ranging from 18 to 62 years. Women and Caucasian participants tended to be younger than men or those from minority ethnic groups, respectively (see Table 1). Cocaine users were on average older than those who reported methamphetamine or amphetamine as their primary drug. Age was significantly correlated with years of use of both stimulants ($r=.57$, $p<.01$) and non-stimulants ($r=.50$, $p<.01$), and older users were more likely to have had previous involvement with TSMHOs. Age was not related to the SYRAAP subscales concerning perceived benefits ($r=.07$, $p=.18$), perceived severity ($r=.06$, $p=.23$), and perceived barriers to TSMHO participation ($r=.03$, $p=.56$) at baseline.

3.2 Stimulant drug use

3.2.1 Age-by-treatment interactions on stimulant drug use—As stated above, with this single model, there are as many interaction effects as there are values of the continuous age predictor, with the statistical significance ($p = .05$) determined if the confidence interval does not include the value of 1.0. For simplicity, the effects of each age are not given. Instead, the age-by-treatment interaction effects are presented in five year increments if statistically significant (Table 2), and in 20 year intervals if not statistically significant (Table 3). Note that the ORs and RRs presented in each table (2 and 3) came from a single model, and are not the result of separate tests. The logistic part (ORs) of the zero-inflation assesses whether or not participants used, while the negative binomial part (RRs) assesses how much they used, if they did use.

As previously noted in Donovan et al. (2013), the odds of abstinence were greater for STAGE-12 participants versus those in TAU. However, those in the STAGE-12 group who were not stimulant abstinent reported a greater rate of use at follow-up compared to TAU. There were age-by-treatment interactions in this study that indicate a moderating effect of age on these results. That is, younger participants in STAGE-12 had greater odds of abstinence compared to TAU than did older participants. For example, the estimated interaction OR of abstinence for those in STAGE-12 compared to TAU for a 20 year old is 4.128 whereas, the odds ratio of abstinence for STAGE-12 versus TAU for a 50 year old is 2.939. The odds of abstinence between STAGE-12 and TAU participants was not statistically different at age 58 and above.

Similarly, in comparing STAGE-12 to TAU treatments, the rate ratio for those who used stimulants is greater for younger than older participants. The estimated interaction rate ratio of stimulant use is 2.191 for STAGE-12 versus TAU participants at age 20, with a reduced RR of 1.652 at age 40. The rate of stimulant use in comparing individuals in STAGE-12 to those in TAU is not statistically different at age 46 and over.

3.2.2 Interaction effects of age or treatment with sex and race on stimulant drug use

—Since age differences were noted on the sex and race demographic variables in this study, auxiliary analyses were conducted on the number of stimulant use days by evaluating the interaction effects of age or treatment, separately, with sex and race (see Table 3). Although a three-way interaction of treatment, age, and either sex or race is considered more appropriate, the complexity of this particular zero-inflated regression model precluded a viable convergent solution and only two-way interactions could be considered. Results indicated no statistically significant interaction effect of age and sex on the number of stimulant use days in terms of abstinence (ORs), nor for the rate of stimulant use up to age 50. However, over age 50, there is a slight effect on the rates of use (RRs) on the limited ages of 52 to 60. That is, the RR is 1.871 (95% CI = 1.004, 3.486) at age 52 and increases up to 2.438 (95% CI = 1.008, 5.898) for age 60, indicating that females have a slightly higher rate of stimulant use for this limited age group when the treatment effect is controlled for. No other statistically significant interactions were seen in any of the other comparisons, including those involving race.

Similarly, cocaine users in this study were on average older than those who reported methamphetamine or amphetamine as their primary drug, therefore an auxiliary analysis was conducted on the number of stimulant use days by evaluating the interaction effect of age with type of stimulant use (cocaine versus methamphetamine/amphetamine). Results indicated no statistically significant interaction effect of age and type of stimulant use on the number of stimulant use days in terms of abstinence (ORs), nor for the rate of stimulant use (RRs).

3.2.3 Sensitivity analysis: Age as a proxy for length of stimulant substance use

—To evaluate the potential for the age variable to be a proxy or surrogate for length of substance use, self-reported maximum number of years of stimulant use was substituted for the age variable as the main predictor in the preceding negative binomial regression models. There were no statistically significant interaction effects between treatment and the baseline

maximum number of years of stimulant use. When the model excluded the interaction effect of this baseline measure with treatment, there was no statistically significant main effect for the baseline measure of maximum number years of stimulant use and rate of stimulant use, indicating that length of substance use was not a proxy for age.

3.3 Non-stimulant drug use

3.3.1 Age-by-treatment interactions on non-stimulant drug use—For non-stimulant drug use, the age-by-treatment interactions were not statistically significant and only the main effect of age was found to be statistically significant. The results indicated a significant age main effect for abstinence ($\beta = 0.043$, $SE = 0.017$, $t_{419} = 2.52$, $p = .012$), but not for rate of use. For example, in comparing a 20-year difference in the increase of age, the odds ratio of abstinence is 2.367 (95% CI = 1.212, 4.626). An estimate of the odds of abstinence of a 40-year difference, such as comparing the youngest participant at approximately 20 years of age with the oldest participant at about 60 years of age, reveals an odds ratio of 5.605 (95% CI = 1.468, 21.398). That is, the odds of abstinence of non-stimulant use increases with age regardless of treatment condition. Although the RR for non-stimulant use indicates a decrease with age, this trend is not statistically significant.

3.3.2 Sensitivity analysis: Age as a proxy for length of non-stimulant substance use—There were no statistically significant interaction effects between treatment and the baseline maximum number of years of non-stimulant use. When the model excluded the interaction effect of this baseline measure with treatment, there was no statistically significant main effect with the baseline measure of maximum number of years of non-stimulant use in abstinence, indicating that age was not a proxy for years of non-stimulant drug use.

3.4 TSMHO meeting attendance

The age-by-treatment interactions were not statistically significant, but the age main effect incidence rate ratio for the number of days of self-reported attendance at AA, NA, CA, or CMA meetings, as measured by the SHAQ, was significant if sex was not included as a covariate in the model ($RR = 1.009$, $\beta = 0.009$, $SE = 0.004$, $t_{426} = 2.50$, $p = .013$). In comparing a 20-year difference in the increase of age, the rate ratio of attendance was 1.208 (95% CI = 1.043, 1.399), whereas a 40-year difference in age indicated a rate ratio of 1.459 (95% CI = 1.088, 1.956). However, when sex was included as a covariate in the model, which reveals a stronger relation to the outcome of attendance ($R = 0.809$, $\beta = -0.212$, $SE = 0.074$, $t_{426} = 2.84$, $p = .005$), age no longer had a significant main effect ($RR = 1.007$, $\beta = 0.007$, $SE = 0.004$, $t_{426} = 1.94$, $p = .053$). Sex did not interact with age in predicting TSMHO attendance.

3.5 Active involvement in TSMHO activities

There were age-by-treatment interactions in this study that indicated a moderating effect of age on TSMHO involvement. Younger participants in STAGE-12 compared to TAU had a greater rate of active participation in TSMHO activities, beyond meeting attendance, than older participants in STAGE-12 compared to TAU (see Table 4). The estimated interaction RR of other TSMHO activities for those in STAGE-12 compared to TAU for a 20 year old is

1.662; whereas, the rate ratio of other TSMHO activities for STAGE-12 versus TAU for a 40 year old is 1.234. The rate of attending other TSMHO activities between STAGE-12 and TAU participants was not statistically different at age 44 and above. When sex was added to the model, the results remained almost identical. That is, sex did have a significant main effect and did not interact with age in predicting this outcome.

4. Discussion

Previously, Donovan et al. (2013) found that STAGE-12 may lead to increased abstinence from stimulant use during treatment, but among people who did not remain abstinent during treatment, those in the STAGE-12 group had somewhat higher rates of use compared to those in TAU. The results of this current study are similar, with the additional evidence that age moderates the treatment effect for both abstinence and rate of stimulant use. Younger participants in STAGE-12 had greater odds of abstinence compared to those in TAU than did older participants, and the rate ratio (STAGE-12 vs. TAU) for those not stimulant abstinent was greater for younger participants than for older adults.

The age groups that encompass emerging adulthood (20–24 and 25–29) showed the strongest response to the STAGE-12 intervention, suggesting that this is an intervention that may be more effective for this population than for older adults for treating stimulant use. In fact, the intervention did not produce significant results in those over 58. It is important to note, however, that there were also higher rates of use among those who did not maintain abstinence in the STAGE-12 group compared to TAU in the younger cohorts.

Donovan et al. (2013) hypothesized that these mixed findings could potentially be attributed to the abstinence violation effect, a theory described by Marlatt (1985) which posits that a person who is committed to abstinence as a goal, but is unable to achieve or maintain that goal, becomes more vulnerable to continued heavy use. Individuals who experience their first lapse as a failure may experience high-levels of guilt and shame, which can lead to an increase in use and difficulty with utilizing the coping skills needed to immediately continue with their recovery. The abstinence violation effect may be stronger in emerging adults, who are likely to have had fewer experiences recovering after a relapse. In addition, some of the reasons that Bergman et al (2016) propose as challenges to providing treatment to emerging adults may be relevant to the abstinence violation effect. For example, younger adults are more likely to have friends who use alcohol and other drugs at higher rates than adults, so once relapse occurs, younger adults return to environments more saturated with use, and presumably more opposed to the tenants of abstinence so intrinsic to TSMHO. It has also been suggested that younger adults may have lower levels of initial motivation for abstinence as a goal, and that this may result in TSF models being a mismatch (Davis, et al., 2017); however, in our sample age was not related to initial readiness for TSMHO participation, and in a post-hoc analysis at 8 weeks, we found that this had not changed. Davis et al. (2017) found, similarly, that relative to older adults, emerging adults receiving TSF compared to Cognitive Behavioral Therapy had higher drinks per drinking day; however this was not maintained at the one-year follow-up. This adds to the idea that TSF could contribute to the abstinence violation effect, specifically in younger adults, however more research is needed to explore this idea further.

Differing from results from this study, Davis et al. (2017) found that emerging adults assigned to TSF had a lower percentage of days abstinent than emerging adults in the other two treatment conditions, and compared to older adults receiving any other treatment modality. It is worth considering why this may be. First the populations are somewhat different; Project MATCH focused on alcohol use and STAGE-12 focused on stimulant use (Donovan, et al., 2013; Project MATCH Research Group, 1998). While, 45% of the STAGE-12 sample also met criteria for alcohol dependence (Donovan, et al., 2013), Project MATCH excluded people who met DSM-IV abuse or dependence criteria for any drug, other than alcohol and marijuana (Project MATCH Research Group, 1998). The focus on stimulants may explain why emerging adults were more responsive to TSF in STAGE-12 than in Project MATCH. The likelihood of more severe consequences of their stimulant use and the fact that the overall emerging adult social context may be less stimulant-rich than it is alcohol-rich may make a treatment that focuses more on abstinence more acceptable and more relevant to these young adults, than those in Project MATCH.

In addition, some factors of the interventions differed; STAGE-12 included an intensive referral component that was not present in Project MATCH; utilized both group and individual sessions, as opposed to all individual; and was embedded within TAU resulting in roughly three sessions of some kind each week, as opposed to the stand-alone intervention offered in Project MATCH. It is possible that these additional sessions provided opportunities to consider more deeply some of the concepts presented as part of STAGE-12. The intensive referral component, in particular, provides an opportunity for active linkage, which may facilitate social network changes that would not occur with the group and individual sessions alone. This recovery role model may help to introduce emerging adults to other young TSMHO members or to older members to whom they can relate. The addition of an intensive referral may be an important factor contributing to social network changes which could mediate the effects of TSMHO participation on stimulant use, and it is a component that distinguishes STAGE-12 from other TSF treatments. Finally, the comparison groups in each study were different: STAGE-12 integrated into TAU was compared to community-based intensive outpatient TAU, whereas Project MATCH compared three distinct interventions.

One potentially relevant mediator of TSMHO attendance that may be more salient in a younger population is impulsivity. A separate analysis of these data indicated that methamphetamine-dependent participants, who are younger, evidence greater impulsivity in contrast to older cocaine-dependent individuals (Winhusen et al., 2013), and generally speaking, impulsivity is a trait frequently associated with emerging adulthood (Littlefield, Sher, & Steinley, 2010). Blonigen et al. (2013) showed that a reduction in impulsivity can mediate the effects of AA on substance use outcomes, so it may be that STAGE-12 reduces impulsivity, and therefore produces greater results among those presenting initially with high impulsivity. Future studies should explore this idea more thoroughly.

Age did not moderate the treatment effects on non-stimulant drug use in this study; however, there was a main effect of age on abstinence, whereby regardless of treatment condition, older individuals were more likely to remain abstinent from non-stimulants at follow-up. Of note, younger adults indicated a preference for non-stimulants, although how this preference

relates to treatment response is unclear. The focus of the intervention was on stimulant use, and it may be that younger adults who preferred non-stimulant drugs were less likely to change patterns of non-stimulant use. Age did not appear to be a proxy or surrogate variable for length of substance use as measured by self-reported maximum number of years for either stimulant use or non-stimulant use.

Similarly, the analysis failed to identify age as a moderator of the treatment effects on attendance at TSMHO meetings. The relation of age to meeting attendance as a main effect was statistically significant, but weak, with roughly a 20% increase for a 20-year difference in age. A more exact interpretation would be that for every one-year increase in age, the difference in the expected number of days of meeting attendance increases by a factor of 0.009 or 0.9%. And, this is only if sex is not included as a covariate, which seems to diminish the effect of age even more.

Age did moderate treatment effects on participation in different types of TSMHO activities to some extent, though; younger adults in STAGE-12 had slightly greater odds of participating in more TSMHO activities compared to TAU than older adults in STAGE-12. That younger people in STAGE-12 were more likely to become actively involved in a variety of TSMHO activities may be related to why this group also has greater odds of abstinence compared to TAU. Active involvement has been shown to predict better outcomes for people of all ages (McKellar, Stewart, & Humphreys, 2003; Montgomery, Miller, & Tonigan, 1995; Subbaraman, Kaskutas, & Zetmore, 2011). Five of the six “other activities” measured by the SHAQ involved interactions with other group members or a sponsor. Contrary what might be expected, increasing pro-abstinent social network members has not been shown to mediate TSMHO for emerging adults, as it has for older adults (Hoepfner, et al., 2014; Kelly, Stout, Greene, & Slaymaker, 2014), however STAGE-12 may act to, at a minimum, encourage contact and opportunities for greater connections with other people seeking recovery.

This analysis has several strengths, such as a large sample size and involvement of multiple clinical sites nationwide, increasing generalizability. In addition, stimulant users and emerging adults are groups often under-represented in the literature. However, there are also several limitations, which should be noted. The analysis relied on the use of self-report measures, which leaves room for misremembering and bias. Also, there was some variation in the TAU provided by the 10 participating sites, and it may be that STAGE-12 is differentially effective according to the characteristics of the treatment program into which it was incorporated. We were unable to control for site. Also, when examining sex and race in this model, we were not able to include three-way interactions, which we consider a more appropriate approach. In addition, due to the complexity of the model, race was reduced to Caucasian and minority ethnic groups combined. Future research should avoid combining racial groups, if possible, as nuances that are likely to exist between non-Caucasian racial groups are lost. In addition, this study did not look at co-morbid psychiatric conditions, which may play a larger role in treatment outcomes for emerging adults. Finally, we cannot rule out the possibility that these results are not a result of generational differences. These data don't allow us to know whether the younger generation in this sample will come to resemble their older counterparts as they age.

4.1 Clinical Implications and Conclusions

Our results highlight the importance of using ongoing assessment in capturing readiness to change to guide treatment focus. Specifically, clients who are in an action-oriented stage of change might benefit more from a STAGE-12-like intervention (STAGE-12 appears to be more effective for individuals demonstrating abstinence), whereas individuals who are more pre-contemplative/contemplative may be better suited for a Motivational Interviewing oriented approach (STAGE-12 does not appear effective with individuals who exhibit continued substance use, and in fact may contribute to increased substance use). Treatment providers should be particularly cognizant of continued substance use that occurs during the period that the STAGE-12 intervention is being delivered. Because the abstinence violation effect appears to be stronger for emerging adults, treatment that includes education about the this effect, as well as lapse management and relapse prevention planning is important. This study adds to the literature suggesting that systematic facilitation to TSMHOs when incorporated within TAU may ultimately increase abstinence among emerging adults, and that additional monitoring may be needed for this age group. More targeted research addressing the differences between younger and older adults and their unique responses to treatment is needed, so that developmental variations can be considered in the provision of substance abuse treatment. Age-appropriate treatment could have considerable effects on clinical outcomes and public health.

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Highlights

- Age moderates the effects of the STAGE-12 intervention on stimulant use.
- Younger age was associated with greater odds of remaining abstinent from stimulants in STAGE-12 versus Treatment-as-Usual.
- Among those who were not abstinent, younger age was associated with greater rates of stimulant use for those in STAGE-12 vs TAU.
- Younger age was also related to somewhat more higher rates of active involvement in TSMHO activities among those in STAGE-12 versus TAU.
- Ongoing assessment of substance use is recommended so treatment modality can be adjusted, if needed.

Table 1

Baseline characteristics by age

	N	Mean Age (s.d.)	F or χ^2	df	p
Sex			14.8	1	.000
Female	266	36.9 (9.5)			
Male	184	40.5 (9.7)			
Ethnicity *			3.0	1	.086
Hispanic	28	35.3 (7.9)			
Non-Hispanic	420	38.6 (9.8)			
Race			40.6	1	.000
Minority	213	41.4 (9.1)			
Caucasian	237	35.7 (9.5)			
Primary drug			16.0	2	.000
Meth/Amphetamine	128	34.9 (8.8)			
Cocaine	245	40.6 (9.6)			
Non-Stimulant	77	37.2 (9.9)			
Past MHO involvement **			6.0	1	.015
Lifetime	270	39.2 (9.5)			
No involvement	172	36.8 (9.9)			

* Data were missing for two participants.

** Data were missing for 8 participants

Table 2

Age-by-treatment interaction odds ratios and incidence rate ratios (STAGE-12/TAU) for the primary outcome of the number of days of stimulant substance use within a 30-day window of assessment at five-year intervals.

Age	Logistic (Abstinence)		Negative Binomial (Count)	
	Odds Ratio	95% CI for Odds Ratio	Rate Ratio	95% CI for Rate Ratio
20	4.128	2.364, 7.208	2.191	1.325, 3.623
25	3.901	2.434, 6.252	2.042	1.332, 3.130
30	3.686	2.469, 5.503	1.903	1.327, 2.729
35	3.483	2.433, 4.986	1.773	1.292, 2.433
40	3.291	2.283, 4.744	1.652	1.200, 2.744
45	3.110	2.004, 4.826	1.539	1.038, 2.282
50	2.939	1.626, 5.312	1.434	0.825, 3.046
55	2.777	1.191, 6.475	1.336	0.586, 4.641
60	2.624	0.727, 9.471	1.245	0.334, 2.156

*
Bold text indicates $p < .05$

Table 3

Interaction odds ratios and incidence rate ratios for the primary outcome of the number of days of stimulant substance use within a 30-day window of assessment.

	Logistic (Abstinence)		Negative Binomial (Count)	
	Odds Ratio	95% CI for Odds Ratio	Rate Ratio	95% CI for Rate Ratio
Age by Sex Interaction				
Age 20	0.857	0.159, 4.603	0.648	0.281, 1.496
Age 40	0.792	0.365, 1.719	1.257	0.851, 1.856
Age 60	0.732	0.123, 4.347	2.438	1.008, 5.898
Treatment by Sex Interaction				
Females	1.235	0.193, 7.896	1.218	0.695, 2.135
Males	0.530	0.083, 3.388	1.229	0.702, 2.153
Age by Race Interaction				
Age 20	1.129	0.202, 6.318	0.692	0.287, 1.670
Age 40	0.809	0.369, 1.773	0.868	0.586, 1.304
Age 60	0.580	0.090, 3.731	1.116	0.431, 2.891
Treatment by Race Interaction				
Caucasian	1.245	0.428, 3.620	0.990	0.298, 3.294
Minority	0.548	0.189, 1.595	0.770	0.723, 2.563

* Bold text indicates $p < .05$

Table 4

Age-by-treatment interaction incidence rate ratios (STAGE-12/TAU) for the outcome of the number of different types of TSMHO activities from the SHAQ within a 30-day window of assessment.

Age	Rate Ratio	95% CI for Rate Ratio
20	1.662	1.248, 2.215
25	1.543	1.223, 1.947
30	1.432	1.189, 1.726
35	1.330	1.138, 1.553
40	1.234	1.062, 1.433
45	1.145	0.965, 1.360
50	1.063	0.859, 1.312
55	0.987	0.757, 1.275
60	0.916	0.664, 1.264