Does age at first treatment episode make a difference in outcomes over 11 years?

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Abstract

This study examines the associations between age at first substance use treatment entry and trajectory of outcomes over 11 years. We found significant differences in individual and treatment characteristics between adult intakes first treated during young adulthood (25 years or younger) and those first treated at an older age. Compared to their first treated older age counterparts matched on demographics and dependence type, those who entered first treatment during young adulthood had on average an earlier onset for substance use but a shorter duration between first substance use and first treatment entry; they also had worse alcohol and other drug outcomes 11 years post treatment entry. While subsequent substance use treatment and 12-step meeting attendance are important for both age groups in maintaining positive outcomes, relationships varied by age group. Findings underline the importance of different continuing care management strategies for those entering first treatment at different developmental stages.

Keywords

substance use treatment; outcome trajectories; young adulthood; life course

1. Introduction

Accumulated evidence shows that substance use disorders are chronic medical conditions (M. Dennis & Scott, 2007; McLellan, Lewis, O'Brien, & Kleber, 2000). Research has documented significant heterogeneity in longitudinal substance use trajectories (Ganguli, Vander Bilt, Saxton, Shen, & Dodge, 2005; Genberg, et al., 2011; Grella & Lovinger, 2011; Juon, Fothergill, Green, Doherty, & Ensminger, 2011; Kertesz, et al., 2012; Satre, 2013; Zucker, et al., 2006), yet factors contributing to variable developmental trajectories are still largely unknown.

The life course perspective has emerged as a new organizing principle for addiction research (Hser, Longshore, & Anglin, 2007; National Institute on Alcohol Abuse and Alcoholism, 2006a). This new perspective provides a useful framework for understanding how substance use affects individuals during stages of development, and how stages of development affect substance use behaviors in the short and long run. This in turn will help develop effective approaches for diagnosing, treating and preventing substance use and related problems, and the management of long-term recovery (National Institute on Alcohol Abuse and Alcoholism, 2008). A key concept of the life course approach is that of turning points. Turning points and their timing (including the timing of first treatment entry) may play an important role in long-term trajectories of alcohol and other drug outcomes (Dawson, Grant, Stinson, & Chou, 2006; Teruya & Hser, 2010). Yet research on the topic, including the relationship between the developmental stage when first treatment occurs (e.g., young adulthood versus middle life/seniors) and outcome trajectories with their associated specific life-stage factors, is sparse.

Young adulthood (18–25 years) is recognized as a critical period for substance use intervention (McGorry, Purcell, Goldstone, & Amminger, 2011; Park, Brindis, Chang, & Irwin, 2008; Stone, Becker, Huber, & Catalano, 2012), as this age group has been found to be most at risk for alcohol and other drug related problems (National Institute on Alcohol Abuse and Alcoholism, 2006b, 2008). Despite high rates of problem use, treatment-seeking rates among young adults are relatively low. Although age at first treatment admission varies across type of substance, national treatment admissions data indicate that the average age is 34 years (Substance Abuse and Mental Health Services Administration, 2011), which is consistent with studies using national treatment or clinical samples (Anglin, Hser, & Grella, 1997; Scott, Dennis, & Foss, 2005). In addition, the period of young adulthood is marked by change and transition. General population studies (Brown, et al., 2008; California Department of Mental Health & Office of Suicide Prevention, Dec 2007; Flora & Chassin, 2005; Garcia, McGeary, Shultz, & McCoy, 1999; Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004) have found that successful developmental transitions, such as educational advancement, employment, marriage, and parenthood, as well as risky transitions such as loss of health insurance, are important. Most studies with a developmental framework have examined the transition from substance use to abuse or dependence, or other high-risk behaviors, in young adulthood (Chassin, Pitts, & Prost, 2002; Ellickson, Martino, & Collins, 2004; Fergusson, Boden, & Horwood, 2008; Guo, et al., 2002; McCambridge, McAlaney, & Rowe, 2011). Few studies have examined effects of developmental transitions on outcome trajectories for young adults in treatment, and how the importance differs between young and older adults.

Evans and colleagues (Evans, Li, Grella, Brecht, & Hser, 2013) examined the developmental timing of first drug treatment and its association with longitudinal drug use patterns. Using pooled data from four longitudinal studies (N=1318), the authors created a sample of individuals first treated either during young adulthood (26%) or at an older age, matched on demographics, primary drug type, age at first use of primary drug and age at first arrest. They compared drug use trajectories over 10 years between the two age groups. While most people in both groups had a low level of drug use after first treatment, young adults had more months of drug use than older adults during the 10-year follow-ups. Multivariate analyses indicated that having first treatment during young adulthood was not associated with patterns of reduced drug use, but receipt of more drug treatment over time was associated with maintenance of a low level of drug use for those first treated as young adults only. This was the first study to examine this question; however, the study focused on drug dependence (rather than alcohol), the majority of whom were sampled from publically funded drug treatment programs (about three-quarters of the sample), with the remaining

from a Veterans Affairs treatment program, jails, emergency rooms, and sexually transmitted disease clinics.

Building on the Evans study, this study aims to examine whether age at first substance use treatment episode is associated with outcome trajectories and associated factors over 11 years among individuals with alcohol and other drug problems who received treatment within an integrated, managed care health system. Similarly, we are interested in the differences between those who entered their first substance use treatment as a young adult (aged 18–25) and those as an older adult (aged 26 and older). We apply a similar approach to match the two age groups on gender, race/ethnicity and dependence type; these factors are strongly associated with substance use patterns, treatment-seeking and retention, and treatment outcomes (Brennan & Moos, 1996; Caetano & Kaskutas, 1995; C. Chen, Durfour, & Yi, 2004–2005; Mertens, Weisner, & Ray, 2005; Ray, Weisner, & Mertens, 2005; Satre, 2013; Schutte, Byrne, Brennan, & Moos, 2001), and thus might have confounded the age differences observed. In addition, we control for age of first use in our multivariate analyses. Research questions are:

1. How do individuals first treated during young adulthood differ from those who are first treated at an older age in individual characteristics at treatment entry, including demographics and onset of use?

2. How do individuals first treated during young adulthood differ from those who are first treated at older age in retention during the first treatment episode, and use of formal and informal services 11 years post the first treatment?

3. After controlling for demographics and dependence type at treatment entry, are there differences in outcome trajectories and associated factors between those first treated during young adulthood and those who are first treated at older age?

2. Materials and methods

2.1. Study site and treatment program

Study participants were drawn from two large randomized studies conducted at the Kaiser Permanente Northern California (KPNC) Chemical Dependency Recovery Program in Sacramento, California. KPNC is a large, private non-profit, integrated health care system covering about 40% of the Sacramento catchment area insured population. It provides substance use and psychiatric services internally. Most members are insured through their own or a family member's employer.

The substance use treatment program provides group-based outpatient and day treatment modalities that include supportive group therapy, education, relapse prevention, family therapy and individual counseling in a model similar to other abstinence-based, group-format private and public programs. Both modalities last 8 weeks and aftercare is available for 10 months. The substance use treatment program and the Psychiatry Department also provide individual and group psychotherapy and medication management. All substance use patients are assigned to (or select) a primary care physician, and are encouraged to use primary care for preventive and ongoing health care.

2.2. Procedures

The Day Hospital Study (DH) compared day hospital to traditional outpatient treatment and recruited patients between 1994 and 1996 (N = 1204) (Weisner, et al., 2000). The Integrated Care Study (ICS) examined integrated delivery of medical and addiction services and recruited patients between 1997 and 1998 (N = 747) (Weisner, Mertens, Parthasarathy, Moore, & Lu, 2001). Program components were consistent across both studies. After

signing informed consents, patients completed baseline interviews conducted by research staff at intake. For both studies, follow-up interviews were conducted at 1, 5, 7, 9 and 11 years, with average response rates of 86%, 81%, 84%, 75% and 75%, respectively. In both studies, drug test results on a random subsample found good validity of the self-report data (Weisner, et al., 2000; Weisner, et al., 2001). Institutional review board approval was obtained from the Kaiser Foundation Research Institute and University of California, San Francisco.

2.3. Measures

Demographic characteristics—The baseline interview asked about age, gender, ethnicity (White, African American, Hispanic, other), education (less than high school, high school graduate, some college or more), household income (less than $40,000 per year or at least $40,000 per year), and significant life events often related to outcomes – marital status and employment status (asked again at follow-ups) (California Department of Mental Health & Office of Suicide Prevention, Dec 2007; Curran, Muthén, & Harford, 1998; McKay, et al., 2005; Miller-Tutzauer, Leonard, & Windle, 1991; Satre, Chi, Mertens, & Weisner, 2012).

Alcohol and drug dependence at treatment entry—At baseline, we used a set of questions from the Diagnostic Interview Schedule for Psychoactive Substance Dependence to provide a DSM-IV diagnosis for alcohol and drug (9 substance types) dependence. For each substance, we established whether 3 of 7 dependence symptoms were present during the previous 30 days. We then classified patients as alcohol dependent, drug dependent, both drug and alcohol dependent, or non-dependent. We also collected data on age first using alcohol and each type of the drugs, and calculated years from first use until first treatment entry. Both age of first use and years till first treatment were categorized (<15 or >15 and 0–9 or >10, respectively) for further analyses based on the distribution of the variables and the literature (Dennis, Scott, Funk, & Foss, 2005).

Alcohol, drug, and related problem severity—Composite scores from the Addiction Severity Index (ASI) (McLellan, et al., 1992) measured alcohol, drug, and related problem severity at all waves (range 0 to 1). For each follow-up, we created a set of dichotomous markers indicating whether the patient had alcohol, drug or psychiatric ASI composite scores greater than zero at the prior interview; these binary markers were proxy measures of need for substance use treatment services in the subsequent period.

Substance use treatment—Duration of index substance use treatment episode was measured in weeks from health plan databases. Treatment readmissions within KPNC were also identified using health plan administrative data and defined as having at least 3 visits (with no more than 30 days gap between each visit) to a program during 2–11 years after intake (Chi, Parthasarathy, Mertens, & Weisner, 2011; Mertens, et al., 2005; Ray, et al., 2005; Satre, et al., 2012; Weisner, Ray, Mertens, Satre, & Moore, 2003). For those who lost KPNC membership, readmissions outside KPNC were captured via patient self-report from the follow-up interviews. Dichotomous measures were created indicating any readmission episode within or outside KPNC in years 2–5, 6–7, 8–9 and 10–11.

Psychiatric services—From the health plan databases, visits to the Psychiatry Department were summarized for the periods between interviews. For those who lost KPNC membership, psychiatric services received outside KPNC were captured via patient self-report from the follow-up interviews. We created a dichotomous indicator of having any psychiatry services within or outside KPNC for each period.

Receiving substance use treatment as needed—In year 1, receiving substance use treatment as needed was defined as completing the index substance use treatment, or not completing it but having readmissions. For each interval between follow-ups during years 2–11, we created dichotomous variables indicating whether the individual received substance use treatment as needed (1= having both alcohol and drug ASI at prior interview equal to zero, or having alcohol or drug ASI at the prior interview above zero and having readmissions). This is consistent with our prior research (Chi, et al., 2011; Parthasarathy, Chi, Mertens, & Weisner, 2012).

Receiving psychiatric services as needed—In year 1, receiving psychiatric services as needed was defined as having psychiatric ASI at treatment entry equal to zero, or having psychiatric ASI at treatment entry above zero and having psychiatric services. For each interval between follow-ups during years 2–11, we created dichotomous variables indicating whether the individual received psychiatric services as needed (1= having psychiatric ASI at prior interview equal to zero, or having psychiatric ASI at the prior interview above zero and having psychiatric services). This is consistent with our prior research (Chi, et al., 2011; Parthasarathy, et al., 2012).

Twelve-step meeting attendance—At the 1-, 5-, 7-, 9- and 11-year interviews, individuals were asked the number of 12-step meetings they attended in the prior 12 months (prior 6 months at 1-year interview). Dichotomous measures were created indicating any 12-step meeting attendance in year 1, years 2–5, 6–7, 8–9 and 10–11.

Alcohol and drug use outcomes—Data on use of alcohol and 11 substances during the prior 30 days were collected at each follow-up interview. For the current study, the primary outcome was remission of substance use disorders at each follow-up defined as in the prior month: being abstinent or not abstinent but drinking 4 or fewer times, and indicating no days of 5+ drinks; not using marijuana more than once; not using drugs other than alcohol or marijuana; and reporting that they did not have suicidal ideations, violent behavior, or serious conflicts with family/friends/co-workers (Chi, et al., 2011; Mertens, Flisher, Satre, & Weisner, 2008; Moos & Moos, 2003; Ouimette, Moos, & Finney, 2000). Additional outcomes included alcohol use, binge drinking (defined as consuming 5+ drinks a day at least once in prior 30 days), marijuana use and drug use in prior 30 days at each follow-up.

2.4. Analytical samples

From the combined dataset of 1951 participants, we identified a total of 817 (41.9%) individuals who had no prior substance use treatment before the index treatment episode. Among them, 146 (17.9%) were first treated during young adulthood (age 18–25 at treatment entry) and 671 during an older age (age>25 at treatment entry). In order to better focus on age differences in patterns and associated factors of outcome trajectories, we created a matched sample to control for potential confounding factors. Three matching criteria were used: gender, race/ethnicity (White, African American, Hispanic, other), and dependence type at treatment entry (alcohol only, drug only, both drug and alcohol, or non-dependent). For sample size considerations, we did not match the two groups on age first starting substance use; but rather controlled for the variables in the multivariate analyses. A final matched sample of 282 individuals was identified (141 subjects from each age group).

2.5. Data analyses

We first compared differences in baseline and treatment characteristics between those first treated during young adulthood and those during an older age in the unmatched (N=817) and the matched (N=282) samples, using chi-square or Fisher's exact tests for categorical variables and t-tests for continuous variables. We also examined the equivalence between

the matched young and older adults using significance tests (Rogers, Howard, & Vessey, 1993). Next, we used the matched sample to examine differences in various alcohol and drug use outcomes by age group over time, including drug use, marijuana use, alcohol use, binge drinking, and remission from substance use disorders, and factors associated with remission and each of the outcomes at follow-ups, by fitting non-linear mixed-effects multivariate logistic regression models with a random intercept. This model examined the effects of the explanatory variables on the participants' probability of a response (e.g., being remitted) while allowing the initial status (i.e., intercept) to vary for every subject. Modeling was conducted in three steps. First, we fitted initial models for each of the outcomes which included only baseline demographic variables. A baseline variable that was significant at p < .10 in at least one of the initial models would be included in all future models. Second, we ran a model for each of the outcomes that included the main effects of the following time-varying predicting factors: marital and employment status at follow-ups, receiving specialty substance use treatment as needed between the prior and current follow-up, receiving specialty psychiatric services as needed between the prior and current follow-up, and any 12-step meeting attendance between the prior and current follow-up, while controlling for the baseline variables. Third, we ran models for each of the outcomes examining interactions between age group, time of follow-up and the time-varying covariates, adjusting for main effects and baseline variables. Due to the power limitations, we examined each of the time-varying covariates individually. Odds ratios (ORs) and the 95% confidence intervals (CIs) for the predictor variables were calculated based on the parameter estimates. All analyses were conducted with SAS version 9.1 (SAS Institute Inc, Cary, NC).

3. Results

3.1. Characteristics at treatment entry

Table 1 compares baseline characteristics of those who first entered substance use treatment as a young adult to those who first entered as an older adult in both unmatched and matched samples. The unmatched sample (N=817) had lower proportions of individuals with college or higher education (22.8% vs. 43.0%), being married (15.8% vs. 48.4%), being employed (50.7% vs. 65.9%), and higher proportions of starting substance use at age 14 and younger (69.0% vs. 47.5%), having durations between first substance use and first treatment entry shorter than 10 years (66.9% vs. 2.1%), and being dependent on drugs only or both alcohol and drugs (53.4% vs. 30.6% and 21.9% vs. 16.2%, respectively), among those with first entry to treatment as a young adult, and on average they had lower alcohol ASI but higher drug ASI composite scores (both p<0.001). Similar analyses of the matched sample showed that the young and older adults at treatment entry were comparable in most baseline characteristics after matching, except for more of the older adults being married, and more of the young adults starting substance use at younger age and having shorter duration between first substance use and first treatment entry, as would be expected. However, the equivalency tests suggested that other than the matching variables, the differences between the two matched age groups were larger than 10% of the means for continuous variables and 20% of the percentages for categorical variables (not shown). Therefore, to adopt a conservative approach, all the baseline variables were examined in the initial models on each of the outcomes (see below).

3.2. First treatment and subsequent services

Analyses of the unmatched sample found that compared to those first treated at an older age, those with first treatment as young adults had lower average length of stay for the first treatment episode (mean/sd=5.6/9.8 vs. 10.9/15.3, p<0.001) (Table 2). Fewer than half of either group had treatment readmissions (within or outside the health plan) when needed after the first year, with significant lower proportions observed in the young adults during

years 2–5, 6–7 and 8–9 (40.0% vs. 54.8%, 36.8% vs. 48.4% and 28.3% vs. 41.7%, respectively; all p <0.05). However, no differences were found in proportions attending any 12-step meetings during the follow-up periods. Most differences between the young and older adults became non-significant when comparing the matched samples, except that the young adults still had lower average length of stay for the first treatment episode (mean/sd= 5.8/9.9 vs. 8.8/14.4, p<0.05) and a lower proportion had readmissions when needed in years 2–5 (40.8% vs. 55.5%, p<0.05) compared to the matched older adult group. The young adult group also had lower proportions receiving readmissions when needed in years 6–7 and 8–9 but only at borderline significance. There were no significant differences between groups in proportions receiving psychiatric services, either in the unmatched or matched samples.

3.3. Alcohol and drug outcomes over time and associated factors

Initial models examining associations between baseline patient characteristics and each of the outcomes indicated that in addition to age group and time of follow-up (coded as 0, 4, 6, 8, 10 at 1, 5, 7, 9 and 11 years, respectively), gender, baseline alcohol and drug dependence type, baseline alcohol ASI score, study indicator (ICS vs. DH), and age of first substance use (>15 vs. <15) were significantly associated with at least one of the outcomes at the p<0.10 level. Race/ethnicity, household income, baseline education level, baseline marital and employment status, baseline drug ASI composite score, and duration between first substance use and first treatment entry were not associated with any of the outcomes over time at the p< 10 level, and thus not included in subsequent analyses (not shown).

We next examined associations between age group, the time-varying predicting factors and each of the outcomes at follow-ups by fitting a series of mixed-effects logistic models, adjusting for the baseline variables retained. Table 3 presents results of models examining remission from substance use disorders, binge drinking and marijuana use. Holding other covariates constant, odds of being remitted from substance use disorders at follow-ups were only about one-third for those who entered first treatment as a young adult compared to those who entered at an older age (OR=0.32, p<0.0001). They were also three and five times more likely to have reported binge drinking or using marijuana more than once, in the prior 30 days at follow-ups. In addition, young adults were half as likely to be abstinent from alcohol (OR=0.47, p<0.01) than their matched counterparts. However, we found no significant differences in abstinence from drugs other than marijuana at follow-ups between the two age groups after controlling for time and other covariates (not shown).

Female gender was positively associated with all outcomes examined except abstinence from drug use other than marijuana. Compared to those who started substance use at age 14 and younger, those who started use older age were more than twice as likely to have positive marijuana use outcomes (OR=2.73, p<0.05). As expected, those with higher baseline alcohol ASI composite scores had lower odds of being remitted and no binge drinking, while those who were dependent on drugs had higher odds of using marijuana more than once at follow-ups. Among the time-varying predicting factors, being married at follow-ups, receiving substance use treatment when needed at follow-ups and having attended 12-step meetings at follow-ups were all positively associated with being remitted at follow-ups (OR=1.83, p<0.01; OR=2.85, p<0.0001 and OR=3.80, p<0.0001, respectively). Receiving substance use treatment as needed and 12-step meeting attendance at follow-ups were both positively associated with alcohol use outcomes at follow-ups, each was independently associated with at least twice the odds of being abstinent from alcohol use and reporting no binge drinking at follow-ups. Receiving substance use treatment as needed at follow-ups was also positively associated with abstinence from drugs other than marijuana and no marijuana use more than once in the prior 30 day at follow-ups (OR=2.00, p<0.05 and OR=2.22, p<0.05, respectively), but 12-step meeting attendance at follow-ups was not significantly associated with either of these two outcomes at follow-ups. Being married at follow-ups was positively

associated with abstinence from alcohol use, no binge drinking, and abstinence from drug use other than marijuana (OR=1.60, p<0.05; OR=2.32, p<0.01 and OR=3.86, p<0.001, respectively). However, employment status was not significantly associated with any of the outcomes examined.

3.4 Interactions between age group, time of follow-up and the time-varying predicting factors

We further examined whether the associations between the time-varying predicting factors and each of the outcomes over time differ by age group. Each time-varying predicting factor was examined individually for each of the outcomes, that is, for each outcome and each time-varying predicting factor, an interaction model including 3 additional interaction terms (age group x time, age group x the time-varying predicting factor, and age group x time x the time-varying predicting factor) was fitted. We found no significant interactions between age group and any of the time-varying covariates on remission, abstinence from alcohol use or abstinence from drug use other than marijuana. However, we found significant interactions between age group and 12-step meeting attendance on no binge drinking over time (Figure 1). Holding other covariates constant, the log odds of no binge drinking decreased over time for young and older adults without 12-step meeting at follow-ups, but increased for young and older adults with 12-step meeting attendance at follow-ups, with more significant increase observed among older adults. We also found significant interactions between age group and marital status at follow-ups, receiving substance use treatment as needed and 12-step meeting attendance on marijuana use over time (Figures 2A–2C). Being married at follow-ups was associated with decreased log odds of no marijuana use more than once for older adults but increased log odds for young adults. However, within the young adult group, the differences between those married and not married decreased over time. Although the log odds of no marijuana use more than once decreased over time for both young and older adults, decreases were smaller among those receiving substance use treatment as needed or with 12-step meting attendance, with more significant effects observed among older adults.

4. Discussion

Several major findings emerged from this study of young and older adults entering their first substance use treatment episode. Compared to those who entered first treatment at age 26 and older matched on gender, race/ethnicity and dependence type, those who entered first treatment at ages 18–25 had on average an earlier onset for substance use but a shorter duration between first substance use and first treatment entry. After entering treatment however, the young adults had shorter length of stay for the index (first) treatment episode, and a lower proportion of them had subsequent substance use treatment readmissions when needed compared to the matched older adults. In addition, the young adults had worse alcohol and other drug outcomes 11 years post treatment entry. While subsequent substance use treatment and 12-step meeting attendance are important for both age groups in maintaining positive outcomes, relationships varied by age group with associations less significant for the young adults.

The relationship between age at first use and later binge drinking, alcohol abuse and/or dependence has been investigated often, and most researchers have found that the earlier the onset, the greater the risk of developing alcohol problems (Grant & Dawson, 1998; Grant, Stinson, & Harford, 2001; Hingson, Heeren, & Winter, 2006; Strunin, Edwards, Godette, & Heeren, 2007). Similarly, epidemiological cohort studies suggest that an earlier age of onset of drug use is associated with higher levels of dependence, and with more serious drug-related problems (Apantaku-Olajide, Darker, & Smyth, 2013; C. Y. Chen, Storr, & Anthony, 2009; Grant & Dawson, 1998; Trenz, et al., 2012). However, little is known about whether

these relationships manifest among those who enter treatment. A cross-sectional study (Darke, Kaye, & Torok, 2012) of 269 regular psychostimulant users (not necessarily in treatment) found that while age at first intoxication appeared stable across birth cohorts, younger age was associated with earlier ages of onset for all classes of illicit drugs. Age was also negatively associated with age at initial injection and regular injection, and age at first treatment. A longitudinal study (Dennis, et al., 2005) of a large heterogeneous sample in a public treatment system found that age of first substance use, age of treatment entry and duration between the two were all independently associated with substance use and treatment careers. In the Evans et al. study, a starting point for the current study, individuals first treated as young adults had higher drug use and incarceration rates over the 10-year follow-up compared with a matched sample of individuals first treated as older adults (Evans, et al., 2013). Although rates of continuing care were low among both age cohorts, receipt of more drug treatment was associated with lower levels of use among those first treated as young adults, but not among the older adults. Our study extended this work with a sample from an integrated health plan, and found that after controlling for potential confounders and age of first substance use, age of first treatment entry was independently associated with treatment retention, readmissions and outcome trajectories over 11 years.

It has been suggested that some young adults "mature out" of substance use problems as they transition into mid-life. Our findings indicated that this process may be prolonged among those who enter into treatment. Those who first entered into treatment in this study had worse outcome trajectories over 11 years than their older adult counterparts, even after matching on potential confounders such as gender, race/ethnicity and dependence type at treatment entry. Later age at treatment entry has been associated with lifetime substance use, and duration of use before starting treatment is related to the length of time it takes to achieve abstinence (Apantaku-Olajide, et al., 2013; M. L. Dennis, et al., 2005; Moos, Nichol, & Moos, 2002; Scott, et al., 2005). In the current study, the young adult group entered first treatment at a younger age and had a shorter duration between first substance use and treatment entry, yet they also had worse outcome trajectories. It is thus important to understand what factors (risk and protective) are associated with the continuous problematic use among young adults.

Receiving services as needed and 12-step meeting attendance are strong predictors of outcomes over time for both age groups, which underlines the importance of formal and informal services for first-time treatment seekers regardless of their age. However, compared to older adults matched on demographics and dependence type, young adults had shorter length of stay for their first treatment episode. Consistent with the Evans et al. (Evans, et al., 2013) study, lower proportions of young adults had readmissions to subsequent substance use treatment, although in the current study these differences became less significant after 5 years. A number of factors may contribute to the trends. Some prior research has suggested that motivation and perceived need for treatment might be lower for those who first entered treatment as a young adult (Edlund, Booth, & Feldman, 2009; Fonsi Elbreder, de Souza e Silva, Pillon, & Laranjeira, 2011; Hedden & Gfroerer, 2011; McKellar, Harris, & Moos, 2006; O'Toole, Pollini, Ford, & Bigelow, 2006). Moreover, other research has suggested that young adults who enter treatment may be less likely to construe their substance use problems within the framework of a "chronic disease." One qualitative study with youth and young adults in substance abuse treatment found that most viewed their substance use problems as a function of poor behavioral choices or a developmental/social lifestyle phase, rather than as an "illness" in need of continuing care (Gonzales, Anglin, Beattie, Ong, & Glik, 2012).

On the other hand, the lower readmission rates among the young adults may signal disparities in access to care. Young adults experiencing life transitions and changes in access

to health care may become vulnerable during the process (Callahan & Cooper, 2004; Cohen & Bloom, 2010; Lyons Jr. & Melton, 2005; Park, Paul Mulye, Adams, Brindis, & Irwin, 2006). For example, before the Patient Protection and Affordable Care Act (ACA) era, young adults moving into their 20s often lost their health insurance and had few opportunities to acquire the traditional employment-based coverage, which affected their service access and utilization. The impact on those with substance use disorders may have been even more significant as it also affected care medical and mental health conditions which are highly comorbid with substance use. The ACA extension of dependent coverage up to age 26 offers new opportunities for prevention, identification and treatment (including continuing care) of substance use disorders for this population, and it will be important to evaluate the effects of that on service access and utilization, care quality, and patient outcomes.

Our findings suggested that marital status is important in maintaining positive substance use outcomes over time for young adults. This is consistent with research findings among community samples (D. S. Bachman, 1997; J. G. Bachman, et al., 2002; Leonard & Rothbard, 1999) that successful developmental transitions, such as gaining employment and forming a romantic or marital partnership, are associated with positive substance use-related outcomes. This is partly due to changed attitudes toward substance use as individuals assume adult roles and responsibilities. (O'Malley, 2004/2005). It is also consistent with the growing literature on "recovery capital," which suggests that increases in recovery capital (that is, the internal and external resources that one can draw upon in initiating and maintaining recovery) are critical for long-term substance use and related outcomes, and different elements of recovery capital are salient at different stages of recovery (Cloud & Granfield, 2008; Laudet & White, 2008). For example, in a study analyzing the full sample of that used in the current study, Satre (Satre, et al., 2012) found that life transitions vary by age and are associated with long-term substance use outcomes. Specifically, at follow-ups the association between change in social networks that encourage substance use and remission from substance use problems are stronger for younger adults, while associations between changed health status and remission over time are stronger for older adults. This emphasizes how important it is for long-term recovery management to address domains other than substance use in treatment programs and continuing care.

Study limitations warrant attention. First, as with all observational studies, our results cannot be interpreted as causal. Second, the study was conducted in an integrated private non-profit health plan, and may not be fully generalizable to other health plan or public populations. Managed care is, however, a major organizational model for private and public health care today, including many state Medicaid arrangements. This health plan is in many ways a model for the health care delivery model now being widely implemented by health reform (Abelson, 2013), and was designated the statewide benchmark for small group plans in the California health insurance exchange. Currently there are at least 19 other U.S. health plans with similar structures. With health reform and the incentives coming with it, other health plans, particularly Federally Qualified Health Centers, will have structural similarities. Moreover, most study findings were consistent with those from the prior Evans et al. (2013) study, which was largely sampled from public treatment settings. Third, although the matching procedure eliminates many pre-treatment differences between the two age groups, this approach limits the number of study participants included in the analyses, and a few baseline characteristics remain different after matching (e.g., marital status at baseline, exact age of onset) which might influence outcome trajectories. We thus conducted modeling in steps and include all the baseline variables that were significantly associated with outcomes at $p<0.10$ in the initial models in subsequent analyses. Fourth, although a key advantage of the mixed-effects modeling approach is that it can be applied when participants are not measured at the same number of time points, and we found no statistically significant

differences in proportions of missingness between the matched age groups across all but one interview waves, some fraction of participants might be missing because they were not remitted. Finally, significance testing may have been limited by the small sample size. Replication studies are needed in other samples and treatment settings to more fully understand outcome trajectories and associated factors for young and older adults throughout recovery.

The concept of turning points in one's life course offers an important perspective for addiction research. Adapting this approach, this study examined the influence of timing of treatment entry and associated factors on outcome trajectories. Our findings underline the importance of different continuing care management strategies for young and older adults and may help inform services design and delivery for individuals with substance use disorders.

Acknowledgments

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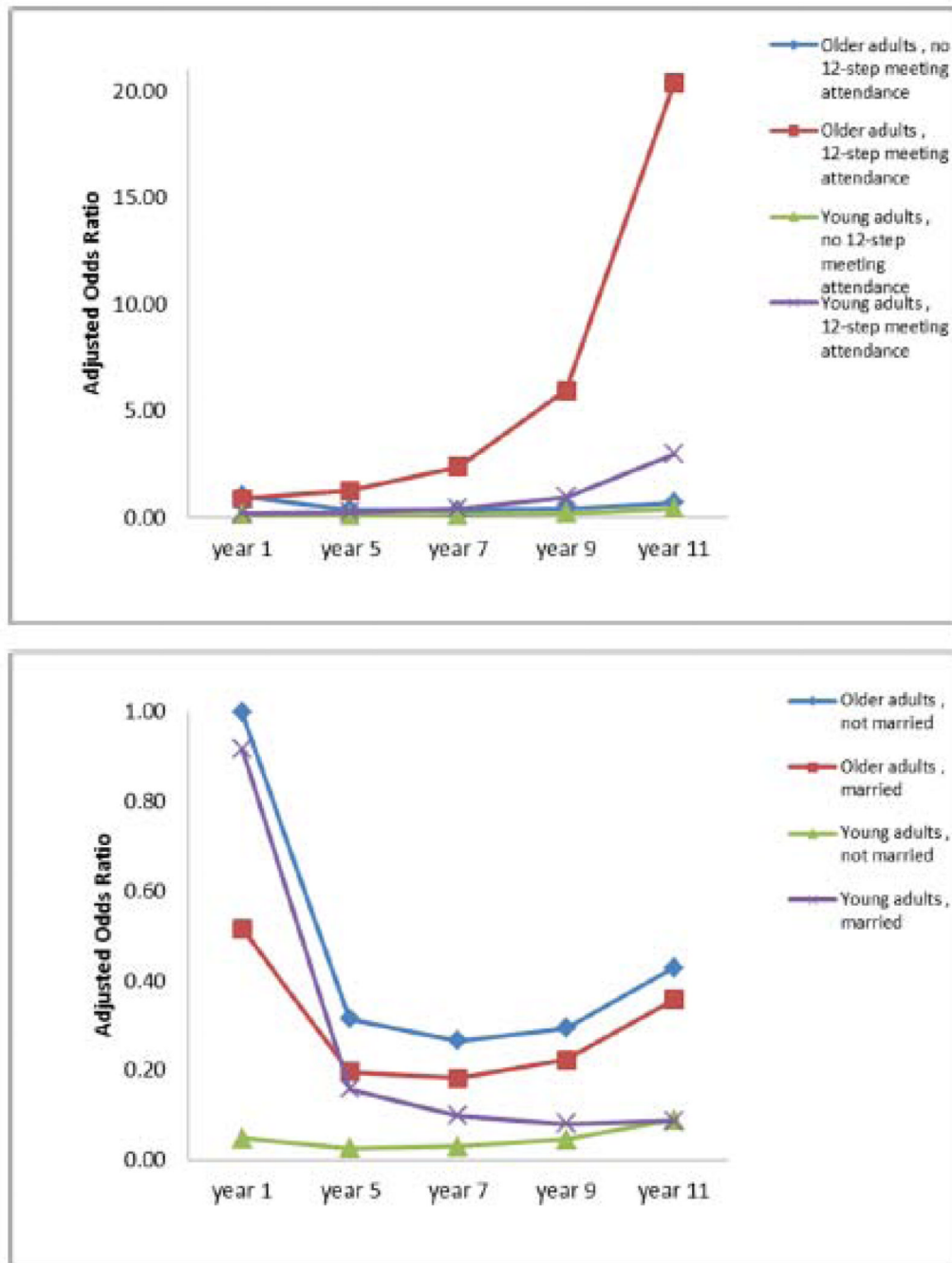
Figure 1.
Adjusted odds ratios of no binge drinking over time by young and older adults with and without 12-step meeting attendance, matched sample
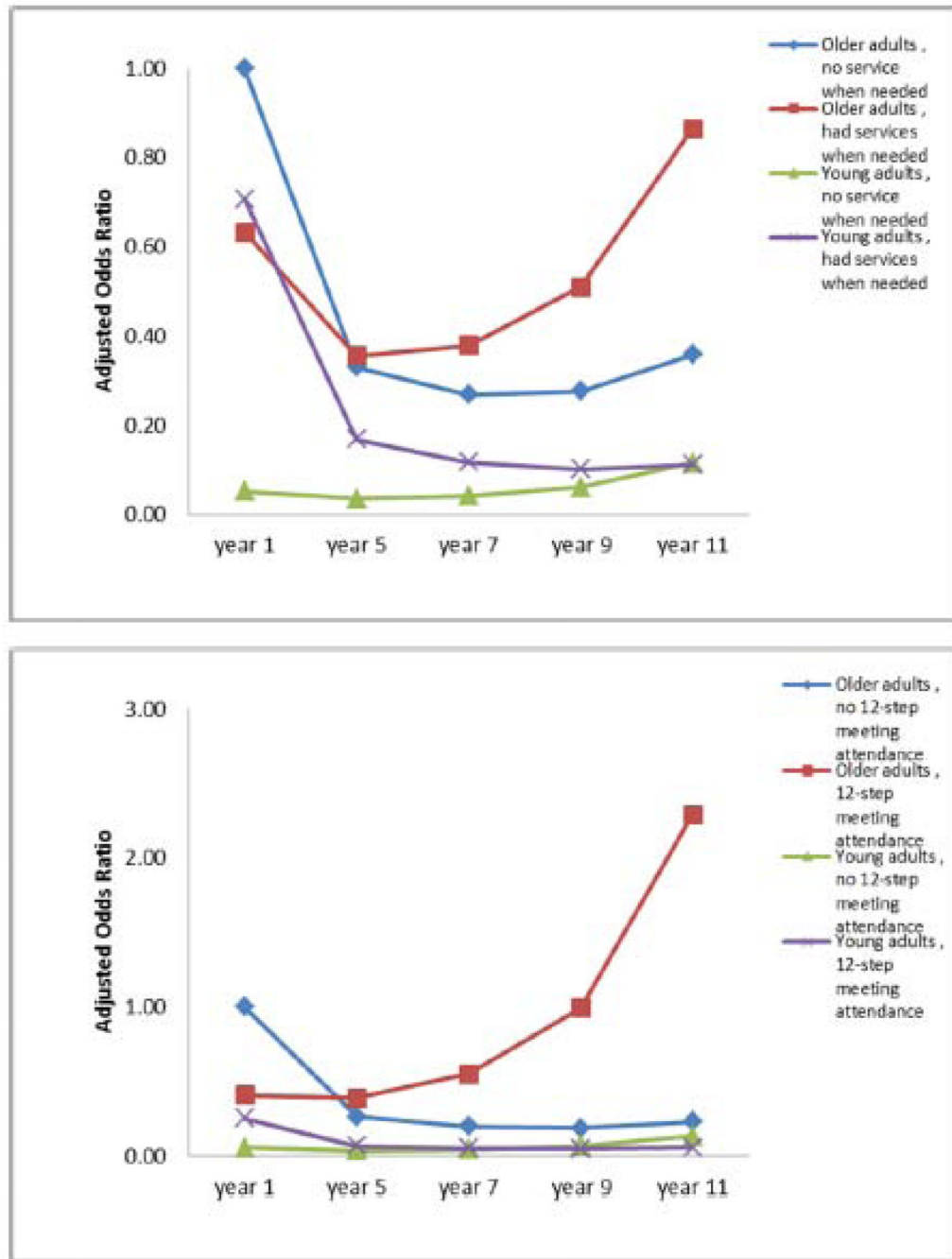
Figure 2.
A. Adjusted odds ratios of no marijuana use more than once per month over time by young and older adults and marital status, matched sample
B. Adjusted odds ratios of no marijuana use more than once per month over time by young and older adults with and without substance us treatment services when needed, matched sample
C. Adjusted odds ratios of no marijuana use more than once per month over time by young and older adults with and without 12-step meeting attendance, matched sample

Table 1

Baseline characteristics by young and older adults who had no prior substance use treatment history

	Unmatched (N=817)			Matched (N=282)		
	Young adults	Older adults	p value	Young adults	Older adults	p value
	(N=146)	(N=671)		(N=141)	(N=141)	
Demographics						
Age at treatment entry, mean (SD)	20.9 (2.5)	39.4 (9.2)	**<0.0001**	20.9 (2.4)	36.6 (7.2)	**<0.0001**
Female (%)	43.2	38.5	0.2919	41.8	41.8	1.0000
Race/ethnicity (%)			0.0546			1.0000
White	72.2	73.6		73.8	73.8	
African American	6.3	12.1		6.4	6.4	
Hispanic	13.2	9.1		13.5	13.5	
Other	8.3	5.3		6.4	6.4	
Education (%)			**<0.0001**			0.1594
Less than high school	24.8	11.3		24.3	17.0	
High school grad.	52.4	45.7		53.6	52.5	
Some college or more	22.8	43.0		22.1	30.5	
Married (%)	15.8	48.4	**<0.0001**	16.3	48.9	**<0.0001**
Employed (%)	50.7	65.9	**0.0006**	51.1	61.0	0.0930
Income>=40K (%)	33.8	38.5	0.2979	35.1	38.1	0.6005
Substance use severity						
Type of dependence (%)			**<0.0001**			0.9769
Alcohol only	15.1	38.0		15.6	15.6	
Drug only	53.4	30.6		53.2	51.1	
Both	21.9	16.2		21.3	23.4	
No dependence	9.6	15.2		9.9	9.9	
Alcohol ASI, mean (SD)	0.3 (0.3)	0.4 (0.3)	**<0.0001**	0.3 (0.3)	0.3 (0.3)	0.4611
Drug ASI, mean (SD)	0.2 (0.1)	0.1 (0.1)	**<0.0001**	0.2 (0.1)	0.2 (0.1)	0.8446
Age of first substance use (%)			**<0.0001**			**0.0359**
Under 15	69.0	47.5		68.6	56.4	
>15	31.0	52.5		31.4	43.6	

	Unmatched (N=817)			Matched (N=282)		
	Young adults	Older adults	p value	Young adults	Older adults	p value
	(N=146)	(N=671)		(N=141)	(N=141)	
Years till first treatment (%)			<0.0001			<0.0001
0–9	66.9	2.1		67.1	2.1	
>10	33.1	97.9		32.9	97.9	
Project (%)			0.0292			0.3392
DHS	54.8	44.9		56.7	51.1	
ICS	45.2	55.1		43.3	48.9	

Note: DHS = Day Hospital Study; ICS = Integrated Care Study. ASI= Addiction Severity Index. SD = Standard Deviation.

Table 2

Treatment characteristics by young and older adults who had no prior substance use treatment history

	Unmatched (N=817)			Matched (N=282)		
	Young adults	Older adults	P value*	Young adults	Older adults	P value*
	(N=146)	(N=671)		(N=141)	(N=141)	
Index (first) substance use treatment						
Length of stay (LOS) in weeks, mean (SD)	5.6 (9.8)	10.9 (15.3)	**<0.0001**	5.8 (9.9)	8.8 (14.4)	**0.0414**
Additional treatment services, years 2–11						
% having readmissions within or outside the health plan in:						
Years 2–5	11.0	13.1	0.4788	10.6	11.4	0.8790
Years 6–7	9.6	5.8	0.0931	9.2	6.4	0.3745
Years 8–9	5.5	2.5	0.1054	5.7	4.3	0.5835
Years 10–11	7.5	3.0	**0.0152**	7.8	5.0	0.3298
% having readmissions within or outside the health plan as needed in:						
Years 2–5	40.0	54.8	**0.0027**	40.8	55.5	**0.0236**
Years 6–7	36.8	48.4	**0.0194**	37.5	49.5	0.0662
Years 8–9	28.3	41.7	**0.0074**	29.3	41.9	0.0504
Years 10–11	39.3	42.4	0.5499	39.8	41.1	0.8571
% having psychiatric services within or outside in: the health plan						
Years 2–5	21.9	26.4	0.2629	22.0	19.9	0.6605
Years 6–7	15.1	16.7	0.6313	14.2	9.2	0.1947
Years 8–9	15.8	11.5	0.1529	16.3	9.2	0.0743
Years 10–11	16.4	11.0	0.0682	17.0	10.6	0.1205
% having psychiatric services within or outside the health plan as needed in:						
Years 2–5	73.2	78.0	0.2485	73.0	74.0	0.8607
Years 6–7	60.8	64.9	0.3893	60.8	61.5	0.9216
Years 8–9	50.0	58.8	0.0825	50.9	62.9	0.0724
Years 10–11	61.5	60.6	0.8465	62.0	65.0	0.6615
% having 12-step meeting attendance in:						
Years 2–5	33.6	31.7	0.6819	34.2	32.1	0.7413
Years 6–7	23.5	31.2	0.1009	23.5	26.7	0.5854

	Unmatched (N=817)			Matched (N=282)		
	Young adults	Older adults	p value*	Young adults	Older adults	p value*
	(N=146)	(N=671)		(N=141)	(N=141)	
Years 8–9	29.9	28.1	0.6940	30.1	27.4	0.6662
Years 10–11	28.3	27.8	0.9167	27.8	26.3	0.8064
Mean (sd) of past-year 12-step meeting attendance in:						
Years 2–5	29.9 (64.2)	25.8 (58.8)	0.4959	30.4 (65.0)	21.9 (54.1)	0.2882
Years 6–7	33.2 (79.2)	23.4 (55.9)	0.2048	31.7 (76.4)	21.8 (52.1)	0.2594
Years 8–9	40.3 (97.6)	20.5 (54.5)	**0.0368**	40.0 (97.7)	23.6 (58.8)	0.1544
Years 10–11	31.1 (89.8)	24.4 (66.3)	0.4610	32.1 (91.7)	24.0 (68.5)	0.4690

Note:

*
p values from Chi-square or Fisher Exact tests for categorical variables, and T-tests for continuous variables.

SD = Standard Deviation.

Table 3

Mixed-effects logistic random intercept models examining factors associated with alcohol and drug use outcomes at 1, 5, 7, 9 and 11 years, among young and older adults who had no prior substance use treatment history, matched on gender, race/ethnicity and dependence type at treatment entry

	Model I: Outcome = Remission					Model II: Outcome = No Binge Drinking					Model III: Outcome = Marijuana Use < Once/Month				
	estimate	std. err.	OR	p	95% CI	estimate	std. err.	OR	p	95% CI	estimate	std. err.	OR	p	95% CI
Intercept	0.6168	0.4753	-	0.1956	-	1.4638	0.5750	-	0.0115	-	4.5739	0.9419	-	<0.0001	-
Time (0,4,6,8,10 at 1,5,7,9,11 yr)	-0.1747	0.0809	0.84	0.0318	(0.72, 0.98)	-0.1989	0.1002	0.82	0.0483	(0.67, 1.00)	-0.2741	0.1199	0.76	0.0231	(0.60, 0.96)
Time square	0.0163	0.0079	1.02	0.0414	(1.00, 1.03)	0.0295	0.0102	1.03	0.0042	(1.01, 1.05)	0.0274	0.0118	1.03	0.0205	(1.00, 1.05)
Women (vs. Men)	0.8246	0.2588	2.28	0.0016	(1.37, 3.79)	1.3800	0.3366	3.97	<0.0001	(2.05, 7.69)	1.1481	0.4805	3.15	0.0176	(1.23, 8.08)
Young adults (vs. older)	-1.1388	0.2600	0.32	<0.0001	(0.19, 0.53)	-1.1720	0.3299	0.31	0.0005	(0.16, 0.59)	-1.6459	0.5012	0.19	0.0012	(0.07, 0.52)
Drug dependence at treatment entry	-0.4377	0.3027	0.65	0.1494	(0.36, 1.17)	0.5972	0.3500	1.82	0.0892	(0.92, 3.61)	-1.9603	0.6148	0.14	0.0016	(0.04, 0.47)
Alcohol ASI at treatment entry	-0.8708	0.4740	0.42	0.0673	(0.17, 1.06)	-1.3536	0.5550	0.26	0.0154	(0.09, 0.77)	-0.9030	0.8568	0.41	0.2929	(0.08, 2.17)
Age of first use>15 (vs. <15)	-0.1435	0.2604	0.87	0.5819	(0.52, 1.44)	-0.2739	0.3208	0.76	0.3940	(0.41, 1.43)	1.0035	0.5008	2.73	0.0461	(1.02, 7.28)
Married at follow-ups (Yes vs. No)	0.6026	0.2145	1.83	0.0053	(1.20, 2.78)	0.8418	0.2764	2.32	0.0026	(1.35, 3.99)	0.5119	0.3344	1.67	0.1270	(0.87, 3.21)
Employed at follow-ups (Yes vs. No)	0.0085	0.2228	1.01	0.9696	(0.65, 1.56)	-0.3703	0.2832	0.69	0.1921	(0.40, 1.20)	0.4598	0.3497	1.58	0.1896	(0.80, 3.14)
Receiving substance use treatment services when needed at follow-ups (Any vs. None)	1.0464	0.2017	2.85	<0.0001	(1.92, 4.23)	1.1661	0.2743	3.21	<0.0001	(1.87, 5.49)	0.7990	0.3245	2.22	0.0145	(1.18, 4.20)
Receiving psychiatric treatment services when needed at follow-ups (Any vs. None)	-0.1773	0.1901	0.84	0.3519	(0.58, 1.22)	-0.2627	0.2383	0.77	0.2714	(0.48, 1.23)	0.0304	0.2902	1.03	0.9167	(0.58, 1.82)
12-step meeting attendance at follow-ups (Any vs. None)	1.3343	0.2406	3.80	<0.0001	(2.37, 6.09)	1.0514	0.3094	2.86	0.0008	(1.56, 5.25)	0.4136	0.3536	1.51	0.2432	(0.76, 3.02)

Note: All models adjust for study sample (ICS vs. DH).