3-1-2019

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Recommended Citation

Erin L. Woodhead, Brenda Booth, Christine Timko, Amanda Tjemsland, Xiaotong Han, and Michael Cucciare. "Longitudinal Health Outcomes and Treatment Utilization Among Emerging, Early-Mid, and Older Rural Adults Using Stimulants" *Journal of Adult Development* (2019): 1-10. <https://doi.org/10.1007/s10804-018-9309-x>

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Longitudinal Health Outcomes and Treatment Utilization Among Emerging, Early-Mid, and
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Funding: This research was supported by the National Institute on Drug Abuse (R01 DA15363 to Brenda M Booth, and R01 DA14340 to Harvey A Siegel, and then to Robert Carlson). Dr. Timko was supported by VA HSR&D (RCS 00-001).

Conflict of Interest: The authors declare that they have no conflicts of interest.

Study approval was obtained from the Institutional Review Boards at the investigators' institutions. All participants provided informed consent. A certificate of confidentiality was obtained from the National Institute on Drug Abuse.

Abstract

There is limited knowledge about age-related differences in health outcomes and treatment utilization among rural stimulant users. The current study examined physical health, mental health, and treatment utilization (hospital, mental health, and substance use care) among 710 stimulant users living in rural areas of the United States. Generalized estimating equations (GEE) were used to examine associations between age and physical health, mental health, and treatment utilization over a three-year period. Analyses controlled for participants' gender, race, and education. To capture age-related differences, participants were grouped into emerging adults (18-25 years old, n=223), early-mid adults (26 to 44 years old; n=384), and older adults (45-61 years old; n=103). At baseline, older stimulant users were in significantly poorer health even though they had significantly fewer substance use problems than emerging adult users. GEE models indicated that substance use outcomes improved for all participants over the course of the study but other outcomes remained stable. Older stimulant users continued to have worse physical health and mental health, even though they had fewer substance use problems, than the other age groups. Older adults also used more hospital and mental health services than the other age groups. We conclude that rural older adults who use stimulants have poor health despite having milder substance use problems and using more health care resources, and need targeted intervention to improve health outcomes.

Keywords: Older Adults, Rural Health, Stimulant Use, Healthcare Utilization, Health outcomes

Longitudinal Health Outcomes and Treatment Utilization Among Emerging, Early-Mid, and Older Rural Adults Using Stimulants

Most research on stimulant use has focused on younger users, yielding little knowledge regarding stimulant use among older adults, especially those living in rural areas. Stimulant use is a critical problem in rural areas (Grant et al. 2007), and is compounded by more barriers to health care in rural compared to urban regions (Borders, Booth, & Curran 2015; Goins, Williams, Carter, Spencer, & Solovieva 2005; Weeks et al. 2004). Older adults often need more health care than younger adults due to an increase in age-related medical conditions (Kessler et al. 2010), though it is unclear whether these age-related differences in health outcomes and health care utilization hold among rural adults who use stimulants. The goal of the current study was to examine the extent to which age group was associated with physical health, mental health, substance use severity, and health care treatment utilization over a three-year period among stimulant users living in rural areas.

Association of Age Group with Health and Treatment Utilization

In the general population, prevalence of physical health problems tends to increase with age (Kessler et al. 2010). The association between stimulant use and physical health is important to examine among older adults living in rural areas due to the difficulties with access to health care in rural areas, as well as the poor physical health of rural older adults (Bacsu et al. 2012; Goins et al. 2005). Older adults who use stimulants may be at even greater risk of health problems due to declining physical health, an increased number of medical conditions, and the long-term effects of chronic stimulant use (Kessler et al. 2010). On the other hand, some research suggests that drug use may not impact health later in life. For example, cannabis use over the course of 20 years was unrelated to physical health at midlife (Meier et al., 2016). In contrast,

alcohol use among older adults is associated with higher risk of medical conditions such as ischemic stroke (Mukamal et al. 2005). Therefore, it is unknown how drug use, specifically stimulant use, affects health outcomes, particularly among older adults living in rural areas.

Rural older adults may have high rates of certain mental health issues, such as loneliness and depression (Theeke, Goins, Moore, & Campbell 2012). Generally, use of stimulants and of alcohol increases the likelihood of mental health problems, such as polydrug use, psychosis, depression, anxiety, and violence (Darke et al. 2008; Grant et al., 2015), though this research is not specific to older adults. There is a critical need to add to the limited research on how stimulant use among rural older adults impacts mental health outcomes given the higher rates of mental health concerns among adults residing in rural regions (Theeke et al. 2012).

In terms of severity of substance use, individuals tend to naturally decrease their use of substances over time (Calabria et al. 2010; Lopez-Quintero et al. 2011), with remission occurring relatively frequently over the course of 5 to 25 years. This suggests that the severity of substance use, assessed via frequency of use and rates of dependence or abuse, may improve with age. However, it is unclear whether this trajectory is similar for stimulant users, given the high rates of dependence among people who use stimulants such as methamphetamine (Darke et al., 2008).

Older age groups tend to use more hospital-based services, in keeping with increasing medical difficulties, but also fewer mental health services, notwithstanding common difficulties such as depression (Cherry, Woodwell, & Rechtsteiner 2007; Wang et al. 2005). The majority of stimulant users do not seek substance use treatment (Curran, Ounpraseuth, Allee, Small, & Booth 2011). Given this context, it is unclear how age group is associated with use of services for physical and mental health problems among stimulant users, and particularly among those living in rural areas having reduced access to health care services (Borders, Booth, & Curran

2015; Goins et al. 2005). Data suggest that stimulant users use hospital resources at higher rates than the average emergency department population, and that they are more likely to be admitted when they present to the emergency department for treatment (Richards et al. 1999), though this research is not informative as to age group of stimulant users.

Association of Gender, Race, and Education with Health and Treatment Utilization

Due to demonstrated associations of gender, race, and education with health and treatment utilization, these variables were controlled in the current study. Women who enter substance use treatment tend to have more severe physical, mental health, and social problems than men do (Greenfield, Back, Lawson, Brady & Brady 2010). However, among younger urban stimulant (crack cocaine) users, men and women reported similar physical and mental health functioning (Bertoni et al. 2014). Regarding race, African-American adults are more likely to receive treatment for illicit drug or alcohol use than other racial and ethnic groups (Substance Abuse and Mental Health Services Administration 2013). Even so, racial and ethnic minority groups who misuse drugs may experience more health problems than their White counterparts (Galea & Vlahov 2002). Generally, more formal education is associated with better physical and mental health (Cutler & Lleras-Muney 2006).

Prior Results with the Present Cohort

Participants for the current study were part of a larger three-year study of stimulant users living in rural areas of Arkansas, Kentucky, and Ohio (Booth et al. 2006; Booth et al. 2010). Prior published data with this cohort found that participants who were white, female, and less educated had poorer physical health and more drug use days in the past month at baseline (Garrity et al. 2007), and that there were negative health consequences of stimulant use (Borders et al. 2009). However, secondary analysis from the same study showed that a reduction in the

number of substances used over the three-year follow-up period was associated with improved mental health (Booth et al. 2010). None of the publications from this study has examined the association of age group with health outcomes and treatment utilization over time.

Current Study

The goal of the current study was to examine the extent to which age group was associated with physical health, mental health, and treatment utilization over a three-year period among stimulant users living in rural areas of the US. As noted, there are limited data on the extent to which age group is associated with these outcomes among stimulant users. Existing research on substance use among older adults has focused on alcohol or drugs other than stimulants. In addition, the literature on stimulant users' health outcomes focuses primarily on younger adults. It is particularly important to examine age-outcome associations among rural stimulant users, as individuals living in rural areas may be in worse health and have less access to health care (Weeks et al. 2004). Older rural stimulant users may be particularly vulnerable to the health effects of these drugs given older rural adults' already higher rates of medical problems compared to younger rural adults and subsequent need for more health care (Bacsu et al. 2012; Goins et al. 2005). Although there is evidence that stimulant users may "age out" of use (Calabria et al. 2010; Lopez-Quintero et al. 2011), unknown is to what extent they experience medical and mental health problems when they survive to older age.

Method

Participants

Study participants were 710 stimulant users living in rural counties of Arkansas, Kentucky, and Ohio (Booth, Leukefeld, Falck, Wang, & Carlson 2006). Counties were classified as rural if they had 50,000 or fewer people, based on the definition of a nonmetropolitan county from the U.S. Office of Management and Budget. Participant demographic information at

baseline is presented in Table 1. The sample was largely younger to middle-aged, had less than a high school education, and was male and Caucasian. In order to be eligible for the study, participants had to report using methamphetamine, crack cocaine, or powder cocaine within the past 30 days, and not receiving any formal or informal drug use treatment in the past 30 days; they also were required to be 18 years of age or older, and have a verifiable address within one of the study counties.

Procedure

Study procedures were approved by the Institutional Review Boards at the investigators' universities. A Certificate of Confidentiality was obtained from NIDA. Participants were recruited using Respondent-Driven Sampling, a type of snowball sampling (Heckathorn 1997; Wang, Carlson, Falck, Siegal, & Rahman 2005). In order to identify potential "seeds," study staff met with drug treatment providers in the local area, distributed research study business cards to individuals who might know drug users, and visited places such as bars frequented by drug users (Draus, Siegal, Carlson, Falck, & Wang 2005). Study seeds were asked to complete a baseline interview and hand out information about the study to up to three people they knew who used drugs. Each seed received \$10 for up to three referred individuals who contacted the study coordinator and were eligible for, and enrolled in, the study. Participants were paid \$50 for each completed study session.

Participants completed informed consent prior to the baseline interview. Follow-up interviews were conducted every six months for a total of 36 months. All interviews were conducted in-person by trained study staff using computer-assisted personal interview software on a laptop computer. Table 1 indicates the retention rates for each follow-up interview; 73% of the initial sample completed all interviews.

Measures

Demographic information. Demographic information was collected at baseline and updated at each follow-up interview so that study staff had current information for locating the participant for the next follow-up interview. In the current study, age group at baseline was the primary independent variable.

Physical health status. Four variables, all collected at baseline and each follow-up, were combined to create an index of physical health (baseline values are presented in Table 2): (1) the total number of 29 possible medical conditions that participants reported they had ever been told by a doctor that they had; (2) the mean number of diagnosed physical ailments, from 0 to 5, over the course of the past six months; (3) the mean seriousness of the diagnosed physical ailments (0=not serious at all to 4=extremely serious); and (4) the medical severity score from the Addiction Severity Index (ASI; McLellan, Luborsky, O'Brien, & Woody 1980), which ranged on a continuous scale from 0 to 1 with higher scores indicating greater severity.

Mental health status. Four variables were combined to create an index of mental health status (baseline values are presented in Table 2): (1) total score on the nine-item Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams 2001), with possible scores ranging from 0 to 27 and higher scores indicating greater severity of depressive symptoms; (2) the mean number of emotional problems, from 0 to 5, experienced in the past six months; (3) the mean seriousness of the emotional problems (0=not serious at all to 4=extremely serious); and (4) the psychiatric subscale of the ASI (McLellan et al. 1980), which ranged on a continuous scale from 0 to 1 with higher scores indicating greater severity.

Substance use severity. Four variables were combined to create an index of substance use severity (baseline values are presented in Table 2): how many days in the past 30 the

participation had (1) had used alcohol and (2) each of 17 drugs; (3) indication by study staff of whether the participant met criteria for an alcohol use disorder in the past 12 months (at the baseline interview) or six months (at the follow-up interviews; scored as yes/no); (4) a count of how many other drugs, out of four, for which the participant met criteria for disorders at any point in the past 12 months (at the baseline interview) or six months (at the follow-up interviews; drugs included cocaine, methamphetamine, opiates, and marijuana).

Treatment utilization. Three types of treatment utilization were examined. Hospital utilization included three variables: 1) number of hospitalizations, from 0 to 5, in the past three years (at the baseline interview) or six months (at the follow-up interviews); 2) number of days for each hospitalization; and 3) number of outpatient visits in the past year (at the baseline interview) or six months (at the follow-up interviews), from 0 to 6, to a medical doctor, nurse, or sexual health clinic (baseline values are presented in Table 2).

Treatment utilization for substance use disorders was assessed with one question that asked participants about the number of weeks they spent in a treatment program in the past three years (at the baseline interview) or six months (at the follow-up interviews) for up to five treatment episodes. A mean was created for number of weeks across the treatment episodes (Moos, 2003).

Treatment utilization for mental health problems was assessed with one question that asked participants about whether they had been treated for emotional problems in the last three years (at the baseline interview) or six months (at the follow-up interviews). Participants could indicate up to five treatment episodes, which were summed to create a variable representing number of treatment episodes for mental health problems in the past three years.

Analysis Plan

The primary independent variable was age group at baseline. Covariates of gender, race (white or nonwhite) and years of education, were included due to their demonstrated association with drug and alcohol use at baseline in the current sample (Borders et al. 2008; Pope, Falck, Carlson, Leukefeld, & Booth 2011). Age was divided into three categories representing emerging adults (18-25 years old, $n=223$; Arnett 2000), early-mid adults (26 to 44 years old; $n=384$), and older adults (45-61 years old; $n=103$). Age was treated as a categorical variable due to the limited research on relatively older users, with most studies not including participants over age 50 (Durell et al. 2008), due to the established age range associated with research on emerging adults (Arnett 2000), and so as to clearly differentiate between adults at different stages of the life course.

The dependent variables were the three composites of health severity (physical, mental, substance use) and three of health care utilization (hospital, substance use, and mental health). The baseline values of the variables that comprised each composite are presented in Table 2. The composites were computed by converting the included variables to z-scores and then taking an average of the z-scores for each composite (Table 1; Blonigen, Hicks, Krueger, Patrick, & Iacono 2005; Blonigen, Bui, Britt, Thomas, & Timko 2016).

One-way analysis of variance with Bonferroni posthoc tests was used to examine differences among the age groups on the composite outcome variables at baseline. We undertook these analyses to examine the extent to which general age differences in health and treatment utilization held among rural stimulant users. Generalized estimating equations (GEE) were used to examine associations between age group at baseline and outcomes at all seven time points, controlling for the baseline covariates of gender, race, and education. GEE was used because it provides population-averaged effects, rather than subject-specific effects in random-effects

models. The models included a continuous time variable that specified when each data point was collected; specifically, time was operationalized as 1 to 7, corresponding to the baseline interview and each of the 6 follow-ups, respectively.

GEEs are based on generalized linear models and account for the non-independent nature of repeated observations in longitudinal studies by specifying a correlation structure. For the current study, an autoregressive correlation structure was specified, which assumes that measurements are less correlated the farther apart they are in time. Additionally, GEEs account for time-dependent variables, such as the outcome composites at baseline and all follow-ups, by including time as an independent variable in the models. When time was a significant predictor in the GEE model, this indicated that the dependent variable (outcome) changed significantly during the course of the study from baseline to the 3-year follow-up. Models were initially run with an age by time interaction to determine whether effects of age differed at each time point over the three-year period. This interaction was not significant for any of the outcomes and so was excluded from the final models. SPSS was used for all analyses with an alpha of 0.05.

Results

Baseline Comparisons by Age Group

At baseline, there were significant differences among the three age groups on the composites of physical health, substance use severity, and treatment utilization for mental health problems (Table 3). The emerging adults were in significantly better physical health than the early-mid and older adults. Even so, the emerging adults had significantly more substance use problems than the early-mid adults and older adults; the early-mid adults also had significantly more substance use problems than the older adults. The emerging adults used significantly fewer mental health services than the early-mid adults. There were no differences among the age

groups on baseline mental health outcomes, treatment utilization for medical services, or treatment utilization for substance use services.

Comparisons Over Time by Age Group

Table 4 shows results for the GEE analyses conducted for the dependent variables. For the outcome of *physical health*, age was significant; the emerging adults and early-mid adults were in significantly better health over time than the older adults. For the covariates, nonwhite participants and women were in better physical health over time than white participants and men.

For *mental health*, a main effect of age group indicated that older adults reported significantly poorer mental health than emerging adults over time, with no significant difference between the early-mid and older adults. Nonwhite participants and women had better mental health over the course of the study than white participants and men.

Substance use severity generally improved over the course of the study. A main effect of age group indicated that older adults had significantly better substance use outcomes over time than emerging and early-mid adults. Men had more substance use problems than women, as did participants with fewer years of education.

Despite participants' improvement over time in substance use outcomes, their outcomes of hospital utilization, mental health treatment utilization, and substance use treatment utilization did not change significantly over the course of the study. Despite their more severe substance use, emerging adults used significantly fewer hospital services than older adults. Nonwhite participants and men used fewer hospital services than white and female participants. Nonwhite participants also reported less use of substance use treatment programs than white participants. Older adults used significantly more mental health services than emerging adults, with no significant difference between the early-mid adults and the older adults. Nonwhite participants

and men used fewer mental health services than white participants and women. There was no association between age group and substance use treatment.

Discussion

In this longitudinal analysis of rural stimulant users, results indicated that substance use severity generally improved over the 3-year course of the study whereas the other outcomes of physical and mental health, and rates of treatment utilization for medical, mental health, and substance use, remained stable. In addition, when examining substance use outcomes by age group, older adults fared even better than the younger age groups on improvement. However, older adults reported worse physical and mental health, and more use of hospital and mental health services, than emerging and early-mid adults.

Our results have several public health implications. First, older adults had better substance use outcomes compared to younger age groups, though they continued to experience poorer physical and mental health. Thus, even though substance use problems may improve over time for older adults, our results suggest that they continue to experience negative health outcomes, perhaps resulting from long-term use of stimulants and other substances. Consistent with this finding, Borders et al. (2009) found that reductions in drug use over a 2-year period resulted in only minor improvements in physical health. Therefore, older adults may “age out” of substance use but continue to experience negative health consequences of long-term use (Calabria et al. 2010; Lopez-Quintero et al. 2011). Our results add to current findings by demonstrating that rural older adults who are using stimulants continue to experience relatively poor health outcomes despite reducing their substance use over time and continuing to use relatively more medical and mental health services.

Second, we found that older and white participants had poorer health and mental health outcomes despite a higher rate of medical and mental health services use. This suggests that the current treatments offered to older, white stimulant users living in rural areas may not be meeting their healthcare needs. It is possible that, due to living in a rural area, these individuals are unable to access high-quality care or specific needed care (i.e., specialists) that would improve their medical and mental health. This is consistent with Bolin et al. (2015) who found that rural adults identified access as their number one health concern, followed closely by mental health/mental disorders and substance abuse. People living in rural areas may make tradeoffs with the quality of their health care and/or may decide not to seek specialized care at a larger medical center due to difficulties with travel (Borders, Booth, & Curran 2015; Wong & Regan 2009).

Third, we found that men had worse substance use outcomes, yet had overall lower rates of use of medical services when compared to women. Male stimulant users living in rural areas may need additional encouragement to seek appropriate medical and mental health services. Prior research on interventions to promote men's health has focused on partnering with community groups and providing services at community-based locations, such as churches, football clubs, barbershops, or other locations outside of a conventional office (Pringle et al. 2013; Roberston, Witty, Zwolinsky, & Day 2013). Some of these initiatives have focused on substance use, such as decreasing tobacco use, though future research is needed to determine whether such programs would be successful in rural areas with stimulant users (Oliffe, Bottorff, & Sarbit 2012).

Our findings support existing literature regarding older adults' increased risk for negative mental health outcomes, including depression and suicide (Bartels & Naslund 2013; Hirsch, Duberstein, Chapman, & Lyness 2007). Even though older adults in our sample were accessing

medical and mental health services more than younger age groups, our results suggest that they were not receiving adequate treatment. Prior research indicates that older adults who have frequent contact with primary care and mental health services may still experience depressive symptoms and suicidal ideation that are undetected (Bartels et al. 2002; Luoma, Martin, & Pearson 2002). Rural older stimulant users may benefit from routine care that offers evidence-based assessments and treatments for detecting and reducing mental health problems. To address problems with access, these services could be delivered via telehealth interventions such as by internet, telephone, videoconferencing, and smartphone mobile applications (Molfenter, Boyle, Holloway, & Zwick 2015). Additionally, education for rural primary care providers on appropriate screening tools for older adults may increase referral to appropriate treatment providers and reduce negative mental health outcomes among rural older adults (Gallo et al. 2013; Moyer 2013).

Limitations

Limitations of the study may impact the generalizability of our findings. In order to participate in the study, participants had to have a verifiable address, so that homeless or transient individuals were not eligible to participate. Additionally, the sample was primarily white, single, and male, which may limit the degree to which our findings generalize to individuals not meeting these characteristics. It is notable, however, that 39% of the sample was female and over 30% nonwhite. We characterized older adults in the sample as anyone age 45 and older to allow a sufficient number of participants in the older group and to examine outcomes among relatively older stimulant users, who are underrepresented in the existing literature. Our findings may not generalize to adults over age 65, which is a common age cutoff used in research on older adults (American Psychological Association 2014).

Conclusions and Future Directions

Results of this study highlight a group of rural stimulant users that may have poor outcomes despite their use of medical and mental health services. Specifically, older adult stimulant users continue to be at high risk of poor medical and mental health outcomes even though they improve over time on substance use. These poor health outcomes may be compounded by older adult stimulant users not receiving the specific types of medical and mental health services that would be of most benefit to them. The lack of practitioners who are trained to work with older adults has been documented (Bartels & Naslund 2013) and may lead to suboptimal services for older adults, particularly around mental health and substance use. It is critical that we continue to strive to improve the quality of medical and mental health care received by older adult stimulant users living in rural areas, to improve their health and mental health outcomes.

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Table 1

Baseline Demographics and Values of the Composite Variables

	Baseline	6 months	12 months	18 months	24 Months	30 months	36 months
Total Participants	n=710	n=603; 84.9%	n=581; 81.8%	n=575; 81.0%	n=561; 79.0%	n=563; 79.3%	n=519; 73.0%
Age, mean (SD)	32.56 (10.35)						
18-25 (Emerging Adults)	223 (31.41%)						
26-44 (Early-Mid Adults)	384 (54.08%)						
45 and older (Older Adults)	103 (14.51%)						
Years of Education, mean (SD)	11.27 (1.86)						
Gender							
Male	436 (61.41%)						
Female	274 (38.59%)						
Race							
White	482 (67.89%)						
African-American	208 (29.30%)						
Other	20 (2.81%)						
Marital Status							
Married/Partnered	112 (15.8%)						
Separated/Divorced	238 (33.5%)						
Never Married	344 (48.5%)						
Current Living Situation							
Own house/apartment	320 (45.0%)						

Someone else's house/apartment	368 (51.8%)						
Employment Status							
Unemployed	353 (49.7%)						
Employed part- or full-time	229 (32.2%)						
Disabled	76 (10.7%)						
Annual Income							
Less than \$5,000	392 (55.4%)						
\$5,000 to \$9,999	117 (16.5%)						
\$10,000 to \$15,999	105 (14.8%)						
Physical Health Composite	-0.06 (0.72)	-0.04 (0.67)	-0.05 (0.67)	-0.05 (0.68)	-0.05 (0.69)	-0.06 (0.68)	-0.05 (0.67)
Mental Health Composite	-0.04 (0.77)	-0.05 (0.80)	-0.07 (0.80)	-0.07 (0.77)	-0.07 (0.80)	-0.08 (0.78)	-0.07 (0.78)
Substance Use Severity Composite	0.09 (0.71)	0.01 (0.68)	0.00 (0.66)	0.01 (0.69)	0.01 (0.69)	0.01 (0.68)	0.00 (0.69)
Hospital Utilization Composite	-0.01 (0.76)	0.05 (0.77)	0.05 (0.82)	0.04 (0.76)	0.06 (0.81)	0.04 (0.77)	0.04 (0.75)

Note. Presented values are means and standard deviations or number of participants and percent.

Table 2

Baseline Raw Scores for Composite Component Variables

Variables	Raw Values	Possible Range
Physical Health Composite		
Historical Health Problems	3.24 (3.05)	0-29
Health Problems in Past 6 Months	0.82 (1.14)	0-5
Seriousness of Past 6 Month Health Problems	2.47 (1.01)	0-4
ASI Medical Subscale	0.31 (0.34)	0-1
Mental Health Composite		
PHQ-9 Total Score	8.88 (6.61)	0-27
Emotional Problems in Past 6 Months	1.43 (1.11)	0-5
Seriousness of Past 6 Month Emotional Problems	2.30 (0.98)	0-4
ASI Psychiatric Subscale	0.20 (0.22)	0-1
Substance Use Severity		
ASI Alcohol Subscale	0.18 (0.19)	0-1
ASI Drug Subscale	0.22 (0.15)	0-1
Met Alcohol Abuse Criteria in Past 6 Months (% Yes)	402 (56.62)	n/a

# of Other Drugs Met Abuse Criteria for in Past 6 Months	1.47 (1.06)	0-4
Hospital Utilization Composite		
Hospitalizations in Past 3 Years	1.79 (1.70)	0-5
Length of Stay for Hospitalization	2.54 (5.58)	0-45
Outpatient Treatment Episodes in Past Year	1.08 (1.83)	0-6
Substance Use Disorder Treatment Utilization		
Weeks in Alcohol/Drug Treatment	2.64 (9.00)	0-88
Mental Health Treatment Utilization		
Treatment Episodes in Past 3 Years	0.23 (0.67)	0-5

Table 3

Composite Variables by Age Group at Baseline

	Emerging Adults	Early-Mid Adults	Older Adults
Physical Health Composite	-0.29 (0.58) ^a	0.02 (0.74) ^a	0.16 (0.77) ^a
Mental Health Composite	-0.11 (0.76)	0.01 (0.76)	-0.09 (0.81)
Substance Use Severity Composite	0.13 (0.73) ^a	0.12 (0.70) ^b	-0.12 (0.63) ^{a, b}
Hospital Utilization Composite	-0.07 (0.65)	0.03 (0.80)	0.01 (0.84)
SUD Treatment Utilization	-0.04 (0.97)	0.04 (1.01)	-0.06 (1.04)
Mental Health Treatment Utilization	-0.11 (0.59) ^a	0.09 (1.21) ^a	-0.10 (0.78)

Note. Physical health: ($F(2, 707) = 19.58, p < .001$); substance use severity ($F(2, 707) = 2.64, p = .005$); mental health treatment utilization ($F(2, 686) = 3.31, p = .037$). Values with the same superscript indicate significant differences between those values as indicated by planned contrasts.

Table 4

Results of GEE models

	Physical Health		Mental Health		SUD Severity		Hospital Utilization		SUD Treatment Utilization		Mental Health Treatment Utilization	
Variables	b	95% CI	b	95% CI	b	95% CI	b	95% CI	b	95% CI	b	95% CI
Intercept	-0.03	-0.32, 0.26	-0.34	-0.71, 0.03	0.17	-0.15, 0.49	-0.14	-0.43, 0.14	-0.22	-0.53, 0.10	-0.08	-0.48, 0.31
Age												
18 – 25 (ref. 45+)	-0.40***	-0.51, -0.28	-0.18*	-0.33, -0.03	0.21***	0.09, 0.33	-0.20***	-0.33, -0.08	-0.03	-0.10, 0.16	-0.24**	-0.41, -0.08
26 – 44 (ref. 45+)	-0.17**	-0.28, -0.06	-0.02	-0.16, 0.11	0.23***	0.12, 0.34	-0.08	-0.20, 0.05	0.09	-0.04, 0.21	-0.04	-0.20, 0.13
Time	0.00	-0.01, 0.01	0.00	-0.01, 0.01	-0.01**	-0.02, 0.00	-0.01	0.00, 0.02	0.00	-0.02, 0.02	0.01	-0.01, 0.02
Race	0.20***	0.12, 0.27	0.35***	0.25, 0.44	-0.01	-0.10, 0.07	0.23***	0.15, 0.31	0.09*	0.00, 0.17	0.29***	0.19, 0.38
Years of Education	0.00	-0.02, 0.02	-0.01	-0.03, 0.02	-0.03**	-0.05, -0.01	0.00	-0.02, 0.02	0.00	-0.02, 0.02	-0.02	-0.05, 0.01
Gender	-0.22***	-0.30, -0.15	-0.27***	-0.37, -0.17	0.14***	0.06, 0.22	-0.23***	-0.41, -0.15	0.06	-0.02, 0.14	-0.20***	-0.31, -0.10

Note. For race, 1=nonwhite, 2=white. For gender, 1=male, 0=female

***p<.001, **p < .01, *p < .05