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Longitudinal trajectories in recovery capital and associations with substance use among adult drug treatment court clients

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Abstract

Background: Recovery capital (RC) refers to the resources individuals use to support substance use disorder (SUD) recovery. Individuals with SUD who are involved with the criminal justice system often have limited RC. Drug treatment courts (DTCs), including traditional drug treatment courts (tDTCs) and opioid intervention courts (OICs), can link clients to important sources of RC in the short-term, but few studies have assessed RC longitudinally.

Methods: The current study analyzed five waves of data from a one-year longitudinal study on substance use and RC collected from clients of tDTCs and OICs (n=165, 52% male, 75% non-Hispanic White, Age=21–67 years). Mixed-effects models examined (1) within-person trends over time in RC, (2) individual characteristics associated with differences and changes in RC, and (3) patterns of relationships between RC and substance use over time. We also tested differences by court type.

Results: First, OIC participants had lower RC at baseline relative to tDTC participants, and there was considerable within-person variability in RC over time. Second, the effect of a high school diploma/GED at baseline on RC change over time was greater for OIC relative to tDTC participants. Third, there was a negative concurrent within-person association between drug use and RC that became stronger over time for OIC relative to tDTC participants.

Conclusions: This study is among the first to examine longitudinal, within-person trajectories in RC. Results revealed important within-person variability over time in RC that was linked

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to education and drug use, particularly among OIC clients. Findings could help inform DTC treatment approaches.

Keywords

recovery; recovery capital; drug court; substance use treatment

1. Introduction

The internal and external resources individuals draw upon to initiate and maintain recovery from substance use disorder (SUD) are referred to as recovery capital (RC; Cloud & Granfield, 2008). RC is conceptualized as consisting of social (e.g., family support), physical (e.g., money, food, housing), human (e.g., knowledge, skills), and cultural (e.g., familiarity with prosocial norms) capital (Hennessy, 2017). Individuals with SUD who are involved with the criminal justice system are an understudied population who often face considerable challenges to accumulating RC (Lantz et al., 2024). Public policies and stigma surrounding justice involvement pose barriers to obtaining safe and affordable housing outside neighborhoods where members are using drugs (physical capital), which in turn limits opportunities to form social networks that support recovery (social capital) and obtain stable employment (human capital; Kahn et al., 2019).

Drug treatment courts (DTCs) offer one response to the challenge of accessing RC. Established in 1989 as an alternative to incarceration for individuals charged with nonviolent drug-related crimes (Fulkerson et al., 2013), traditional DTCs (tDTCs) help by linking clients to important sources of RC, such as substance use treatment, physical/mental healthcare, housing, employment, and social supports (Kahn, Thomas, et al., 2022). The judge and a multidisciplinary team of professionals conduct case management and regular drug testing, and can impose sanctions for noncompliance with abstinence mandates (Mitchell et al., 2012). Evaluations of tDTCs indicate that participants have a lower rate of recidivism than non-participants (Mitchell et al., 2012), including lower likelihood of arrest (Krebs et al., 2007), longer time to first re-arrest (Banks & Gottfredson, 2004) and fewer charges and convictions (Kearley et al., 2019; Kearley & Gottfredson, 2020). Participants who are employed or are students within the first month of admission have higher tDTC graduation rates, suggesting that employment and education may be important for subsequently accruing RC during tDTC participation (Gallagher et al., 2018).

A growing percentage of individuals with opioid use disorder (OUD) have been enrolling in tDTCs over the last decade (Matusow et al., 2013), yet participants with OUD are over 80% less likely to graduate from tDTC compared to participants without OUD (Gallagher et al., 2018). This considerable discrepancy may be at least partially attributable to individuals with OUD having lower RC early in recovery relative to individuals with other SUDs (Kelly et al., 2018).

To better assist individuals with OUD, an opioid intervention court (OIC) was established in Buffalo, NY, in May 2017. Similarities and differences between OIC and tDTC are summarized in Figure 1. OIC is intended for individuals charged with a nonviolent offense who are at high risk of fatal opioid overdose (Kahn et al., 2021). As with tDTC, OIC links clients to RC through peer recovery support, mental/physical health providers, vocational/educational services, and housing and transportation. OIC is unique in providing a shorter and more intensive intervention than tDTC through immediate linkage to substance use treatment, including medication for opioid use disorder (MOUD), ideally within 24-hours of participants' first appearance before the judge. Participants meet one-on-one with the judge every day for 90 days and have an 8PM home curfew with a nightly check-in via text/phone with a court case manager. In contrast, most tDTCs often require participants to be monitored over a 12–18-month period covering three phases: stabilization, intensive treatment, and transition (Cornwell, 2019; Logan & Link, 2019). Depending upon the phase, tDTC participants may report to court weekly, biweekly, or monthly, with the caveat that much procedural variation exists among tDTCs and jurisdictions (Andraka-Christou, 2016; Cornwell, 2019; Logan & Link, 2019). Although frequent drug testing is required in the OIC, participants are not punished for positive tests. In sum, immediate linkage to treatment in combination with more frequent and less punitive contact with judges/case managers distinguishes OIC from tDTC (Kahn et al., 2021).

Despite evidence of DTCs linking clients to RC in the short-term, few studies have assessed RC longitudinally (in the context of DTC or otherwise) to track longer-term trends (Best & Hennessy, 2022). Most theories posit not only that individuals have different amounts of RC, but also that RC is dynamic and changes over time (Best & Hennessy, 2022). Moreover, according to theory, RC should be more strongly linked to declines in substance use over time as recovery becomes more stable (Kelly & Hoeppner, 2015). Indeed, obtaining RC during SUD treatment has been negatively associated with problematic substance use (Sánchez et al., 2020) and criminal activity (Bormann, Weber, Miskle, et al., 2023) as well as positively associated with treatment completion (Headid et al., 2024). Subsequently, lower-risk substance use and longer lengths of stay in treatment or recovery residences are linked to greater RC and positive wellbeing (Cano et al., 2017; Eddie et al., 2022; Jason et al., 2020). However, RC assessment strategies to date have been designed to capture static, between-person differences rather than dynamic, within-person changes (Palombi et al., 2019; Sánchez et al., 2020). Studies are lacking that assess RC repeatedly over time and explore within-person trajectories.

To address these gaps in the literature, the current study analyzed five waves of data from a one-year longitudinal study on substance use and RC collected from clients of tDTCs and OICs. The first aim was to describe within-person trends in RC over time, as well as potential differences by DTC. We expected RC to increase across time in recovery on average (Kelly & Hoeppner, 2015), and for OIC clients to have lower initial RC than tDTC clients (Kahn et al., 2021). The second aim was to determine whether individual differences in sociodemographic characteristics were associated with (a) overall RC levels, and (b) mean change over time in RC. We also tested whether associations differed by DTC. The third aim was to examine concurrent associations between substance use (which in this study refers generally to the three substance use variables—tobacco, alcohol, and drug use—that we considered in our analyses) and (a) RC levels, and (b) mean change over time in RC. We also tested whether associations differed by DTC. We expected negative associations between substance use variables and RC across time in recovery (Kelly & Hoeppner, 2015). Understanding within-person variability in RC and its associations with individual characteristics and substance use behaviors could help DTCs provide tailored treatment approaches (Kahn, Wozniak, et al., 2022).

2. Material and methods

2.1 Participants and procedures

The current study utilized data from an ongoing, one-year longitudinal survey-based study, Health Evaluation of the Results of Opioid Intervention Court (HEROIC). This larger study focused on the impacts of two distinct court settings, the traditional drug treatment court (tDTC) and opioid intervention court (OIC), on participant outcomes. Clients were eligible if they were able to speak English, had a history of opioid use, and were 18 years of age or older. This study was approved by the University at Buffalo Institutional Review Board.

DTC clients were recruited during video-conferenced court sessions during the COVID-19 pandemic and in-person once regular court operations resumed. Potential participants were also recruited through a DTC case manager and a transitional case management program from January 2021 through July 2023. Prospective participants completed an eligibility screener via REDCap, a secure, web-based survey application (Harris et al., 2019). Each participant who completed the screener was mailed a $5 gift card, irrespective of eligibility status. Of the 210 individuals screened, 171 (81%) were eligible for the study and consented. Six individuals (N_{OIC}=3; N_{tDTC}=3) agreed to participate but did not complete the baseline assessment, leaving a final sample size of 165 (79% of individuals screened/96% of individuals enrolled) who provided complete data at baseline via REDCap. Recruitment rates were similar between OIC (80 screened/64 enrolled; 80%) and tDTC (130 screened/107 enrolled; 82%). A total of 21 individuals (N_{OIC}=9; N_{tDTC}=12) were eligible but did not participate. Reasons for nonparticipation included being unable to reach the individual after eligibility screening (N_{OIC}=7; N_{tDTC}=8), individual was not interested in enrolling (N_{OIC}=2; N_{tDTC}=3), and insufficient contact information after screening (N_{OIC}=0; N_{tDTC}=1). The study involved five waves of data collection at baseline and Months 3, 6, 9, and 12. Upon completion of the survey, participants received gift cards as compensation worth $50, $65, $75, $85, and $95 for Waves 1–5, respectively.

2.2 Measures

2.2.1 Sociodemographic characteristics—Demographic information was collected at the baseline assessment and is summarized in Table 1. Briefly, the sample was 52% male and predominantly non-Hispanic White (75%), unemployed (69%), unmarried/single (79%), and high school educated (88%). The age range was 21–67 years (M_{age}=36.75, SD_{age}=9.70). Medication use across all persons and waves included buprenorphine (24%), methadone (16%), naltrexone (4%), and other (0.3%).

The sociodemographic predictors we considered in these analyses were: age (in years), sex (0=male, 1=female), employment status (0=unemployed, 1=employed), marital status (0=unmarried, 1=married), education (0=less than high school, 1=high school or greater), and race/ethnicity (0=racial or ethnic minority, 1=non-Hispanic White). DTC was coded as 0=tDTC, 1=OIC. Age was treated as continuous and grand-mean centered; all other variables were treated as binary. These variables were selected as predictors of RC due to their associations with RC and SUD recovery more broadly (Beaulieu et al., 2023; Eddie et al., 2022; Gallagher et al., 2018; Smith, 2017). Although some of these predictors (e.g., education, employment) are aspects of RC, they are not imbedded within RC measures (Vilsaint et al., 2017), and may explain important between-person variability in RC trajectories over time.

2.2.2 Recovery capital—Recovery capital was assessed at each wave via the Brief Assessment of Recovery Capital (BARC; Vilsaint et al., 2017), which consists of 10 items assessed from 1 (*Strongly disagree*) to 6 (*Strongly agree*). Items were summed for each participant at each wave to create a total score ranging from 10—60, with higher scores indicating higher levels of RC. A generalizability theory approach (Shrout & Lane, 2012) indicated that within-person change in recovery capital ($R_C = 0.90$) was measured reliably.

2.2.3 Drug use—Any drug use in the past three months was assessed at each wave with items from the National Institute on Drug Abuse-Modified Alcohol, Smoking and Substance Involvement Screening Test (WHO ASSIST Working Group, 2002). Items asked about non-medical use of prescription drugs, including stimulants, sedatives, opioids, and/or other drugs, as well as the use of illicit substances including cannabis, cocaine, methamphetamine, inhalants, hallucinogens, street opioids, and other. A dichotomized variable of *any current drug use* was coded as yes (1) or no (0).

2.2.4 Tobacco use—Tobacco use was assessed at each wave by asking participants whether or not they used any tobacco products in the past three months, including cigarettes, cigars, e-cigarettes, and smokeless tobacco. A dichotomized variable of *any current tobacco use* was coded as yes (1) or no (0).

2.2.5 Alcohol use—Alcohol use in the past three months was assessed at each wave via the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 1992), which consists of 10 items assessed from 0 (*Never*) to 4 (*Daily or almost daily*). Total scores range from 0—40, with higher scores indicating greater likelihood of hazardous and harmful alcohol use. A dichotomized variable of *current harmful alcohol use* was coded as yes (1) if AUDIT total score ≥ 8, and no (0) if AUDIT total score < 8 (Saunders et al., 1993).

2.3 Data analysis

2.3.1 Descriptive statistics—Descriptive analyses included calculating means, SDs, ICCs, and within- and between-person correlations among primary study variables, for the total sample and separately by DTC. Person-average RC, drug use, tobacco use, and alcohol use variables were calculated as the mean of the respective wave-level scores across all waves for each participant. Person-average variables were grand-mean centered and within-person, wave-level variables were person-mean centered to parse between- and within-person variance.

2.3.2 Longitudinal trajectories in RC—Model building proceeded in a stepwise fashion consistent with our research aims. The first aim was to describe within-person trends in RC, as well as potential differences by DTC. Two separate linear mixed-effects models were estimated. The first model included only the main effect of wave number on RC, specified as:

$$RC_{wi} = \gamma_{00} + \gamma_{10}(Wave_{wi}) + u_{0i} + u_{1i}(Wave_{wi}) + \varepsilon_{wi} \tag{1}$$

RC_{wi} (wave's RC) was the RC reported on wave w by individual i. The γ_{00} parameter was the intercept and represented the level of RC predicted at the first wave of the study for a typical participant. The γ_{10} parameter indicated the expected unit change in RC across each wave of the study, averaged across all participants. The u terms represented deviations for individual i from the γ estimates capturing RC level at wave one (u_{0i}; random intercept) and rate of change in RC over time (u_{1i}; random slope). Finally, e_{wi} were errors. A quadratic effect of time on RC was tested in addition to the linear effect of time but this effect was not significant. As such, the more parsimonious model was retained.

The second model included a main effect of DTC and an interaction between wave number and DTC to capture DTC differences in RC levels and mean change over time:

$$RC_{wi} = \gamma_{00} + \gamma_{01}(DTC_i) + \gamma_{10}(Wave_{wi}) + \gamma_{11}(DTC_i) * (Wave_{wi}) + u_{0i} + u_{1i}(Wave_{wi}) + \varepsilon_{wi} \tag{2}$$

RC_{wi} was again the RC reported on wave w by individual i. The γ_{00} parameter was the intercept and represented the level of RC predicted at the first wave of the study for a tDTC participant. The γ_{01} parameter indicated the expected difference in RC for OIC relative to tDTC participants at the first wave of the study. The γ_{10} parameter indicated the expected unit change in RC for one wave of the study for tDTC participants. The γ_{11} parameter indicated the expected shift in the change of RC for one wave of the study for OIC relative to tDTC participants. The u terms represented deviations for individual i from the γ estimates capturing RC level at wave one (u_{0i}; random intercept) and rate of change in RC over time (u_{1i}; random slope). Finally, e_{wi} were errors.

2.3.3 Sociodemographic predictors of RC—The second aim was to examine associations between sociodemographic predictors and (a) overall RC levels, and (b) mean change over time in RC. We also tested whether associations differed by DTC. Two separate mixed-effects models were estimated. The first model included main effects of sociodemographic predictors, wave number, and DTC on RC, specified as:

$$RC_{wi} = \gamma_{00} + \gamma_{01}(Age_i) + \gamma_{02}(Female_i) + \gamma_{03}(Employed_i) + \gamma_{04}(Married_i) + \gamma_{05}(HS_i) + \gamma_{06}(NHWhite_i) + \gamma_{07}(DTC_i) + \gamma_{10}(Wave_{wi}) + u_{0i} + \varepsilon_{wi} \tag{3}$$

RC_{wi} was again the RC reported at wave w by individual i; γ_{00} was the intercept representing the RC expected at the first wave of the study for the tDTC group when age equaled the sample-average value and all other variables were at zero (u_{0i} captured person-to-person variability in this term). Holding constant the other predictors in the model, γ_{01} indicated the expected difference in RC for each unit difference in age from the sample mean, $\gamma_{02} - \gamma_{07}$ indicated the expected differences in RC when each respective predictor was equal to one, γ_{10} indicated the expected unit change in RC across each wave of the study, and ε_{wi} were errors.

The second model was the same as the first, except that it additionally included interactions among sociodemographic predictors, DTC, and wave number to capture change in the associations between sociodemographic predictors and RC over time, and differences by DTC. All interactions among (a) DTC and sociodemographic factors, and (b) wave number and sociodemographic factors were tested; only significant interactions were retained in the final model.

2.3.4 Associations between substance use variables and RC—The third aim was to examine concurrent associations between substance use (including tobacco, alcohol, and drug use) and (a) RC levels, and (b) mean change over time in RC. We also tested whether associations differed by DTC. Two separate mixed-effects models were estimated. The first model included main effects of substance use variables, wave number, and DTC on RC, specified as:

$$RC_{wi} = \gamma_{00} + \gamma_{01}(PDRUG_i) + \gamma_{02}(PTOB_i) + \gamma_{03}(PALC_i) + \gamma_{04}(DTC_i) + \gamma_{10}(Wave_{wi}) + \gamma_{11}(WDRUG_{wi}) + \gamma_{12}(WTOB_{wi}) + \gamma_{13}(WALC_{wi}) + u_{0i} + u_{1i}(Wave_{wi}) + \varepsilon_{wi} \quad (4)$$

The model again accounted for the nesting of waves (Level 1) within persons (Level 2) using a random person-level intercept (u_{0i}). $\gamma_{11}(WDRUG_{wi})$ captured the average wave-level association between any current drug use and RC, $\gamma_{12}(WTOB_{wi})$ captured the average wave-level association between any current tobacco use and RC, and $\gamma_{13}(WALC_{wi})$ captured the average wave-level association between any current harmful alcohol use and RC. We were interested in separating changes in RC attributable to use of each substance at the current wave from differences in RC attributable to the cumulative effects of using these substances across all waves. Therefore, the proportion of waves that each person reported engaging in any drug use ($\gamma_{01}(PDRUG_i)$), tobacco use ($\gamma_{02}(PTOB_i)$), and alcohol use ($\gamma_{03}(PALC_i)$) were included in the model to ensure that relationships between substance use variables and RC were purely within-person, wave-level relationships. As a result, the Level 1 associations are interpreted as the average within-person, wave-level associations, adjusted for person-level effects; the Level 2 associations are the between-person associations. Finally, holding constant the other predictors in the model, $\gamma_{04}(DTC_i)$ indicated the expected difference in RC for OIC relative to tDTC participants, $\gamma_{10}(Wave_{wi})$ indicated the expected difference in RC for each unit increase in wave number (u_{1i} was the random slope capturing person-to-person variability in this term), and ε_{wi} were errors.

The second model was the same as the first, except that it additionally included interactions among substance use variables, wave number, and DTC to capture change in the associations between substance use variables and RC over time, and differences in rates of change by DTC. All interactions among (a) DTC and wave's drug/tobacco/alcohol use, and (b) wave number and wave's drug/tobacco/alcohol use were tested; only significant interactions were retained in final model. Both models additionally retained main and interaction effects of sociodemographic variables that were significantly associated with RC in the previous model fitting step (results did not change when they were excluded). All models were fit using the lme4 package in R (Bates et al., 2015); p-values were calculated using lmerTest (Kuznetsova et al., 2017). Consistent with the modeling framework, missing data on the outcome variable were handled using maximum likelihood estimation, whereas listwise deletion was used when data were missing on predictor variables. Bootstrapping with 10,000 simulations was used to calculate 95% confidence intervals.

2.3.5 Sensitivity analyses—We investigated whether results were robust to subtle variations of our analytic decisions, including when (a) only including participants with at least two waves of data and non-zero within-person variability in RC over time (n=142), (b) controlling for between-person differences in the number of waves of data collection completed, and (c) conservatively computing the denominator degrees of freedom based on the number of participants rather than the number of observations. We also examined whether the pattern of results was similar when limiting the operationalization of drug use to be specific to any current opioid use (yes/no), given the centrality of opioid use to individuals involved in OIC.

3. Results

3.1 Descriptive statistics

The sample size ranged from n=165 at Wave 1 (N_{OIC}=61) to n=103 at Wave 5 (N_{OIC}=42). Primary reasons that participants were lost to follow-up included being deceased or incarcerated. A smaller percentage declined to participate in the follow-up assessments. To investigate the potential impact of missingness on the final analytic sample, we examined whether participants who completed all five waves of data collection (n=97) differed on the primary study variables from participants who did not complete all five waves of data collection (n=68). Independent samples t-tests and chi-square tests indicated that participants completing vs. not completing all five waves did not significantly differ on any of the study variables, including RC, substance use, and sociodemographic variables. Thus, it is unlikely that listwise deletion undercut the validity of the primary analyses.

Descriptive statistics are presented in Table 2. On average, RC was higher among tDTC (M=49.1) compared to OIC participants (M=43.5). An overall ICC of 0.54 demonstrated that a considerable proportion of variance in RC (46%) was at the within-person level, indicating substantial within-person variability in RC over time. Only six participants who completed at least two waves of data collection reported no variability in RC. Drug use was more common across time among OIC participants (74% of reports) compared to tDTC participants (36% of reports). Tobacco and harmful alcohol use rates were more similar between groups.

Correlations among study variables are presented in Table 3. RC was negatively correlated with drug, tobacco, and alcohol use within-persons (rs= −0.01 – −0.17) as well as between-persons (rs= −0.12 – −0.18). Correlations tended to be stronger for OIC relative to tDTC participants, especially the negative correlation between RC and drug use at the within-person level (tDTC $r = -0.13$ vs. OIC $r = -0.24$).

3.2 Longitudinal trajectories in RC

Results from analyses examining linear trends in RC over time are presented in Table 4. Within-person trajectories in RC over time for all participants, as well as the average slopes for tDTC and OIC participants, are shown in Figure 2. On average, the linear trend in RC was positive over time, but this trend was not significantly greater than zero (b = 0.25, 95% CI [−0.19, 0.69]; Model 1). OIC participants had lower RC at baseline relative to tDTC participants on average (b = −6.41, 95% CI [−9.47, −3.32]; Model 2); the linear mean change in RC over time did not differ between tDTC and OIC groups (b = 0.59, 95% CI [−0.32, 1.49]; Model 2).

3.3 Sociodemographic predictors of RC

Results from analyses testing sociodemographic predictors of RC are presented in Table 5. After controlling for differences in RC due to DTC and wave number, none of the sociodemographic variables were associated with RC levels (Model 1). The addition of interactions in Model 2 revealed a significant three-way interaction among education, wave number, and DTC (b = 4.31, 95% CI [1.48, 7.11]), depicted in Figure 3. The effect of a high school diploma/GED at baseline on RC change over time was greater for OIC relative to tDTC participants. OIC participants with a high school diploma/GED at baseline exhibited greater positive linear mean change in RC over time on average relative to OIC participants without a high school diploma/GED at baseline, a pattern that was not observed for tDTC participants. No other interactions were significant.

3.4 Associations between substance use variables and RC

Results from analyses examining associations between substance use variables and RC are presented in Table 6. After adjusting for differences in RC attributable to DTC, wave number, significant sociodemographic predictors, and participants' proportion of waves with reported use of each substance, wave's drug use (b = −2.95, 95% CI [−4.75, −1.17]) and wave's alcohol use (b = −3.94, 95% CI [−6.52, −1.31]) were independently associated with lower concurrent RC within-persons in Model 1. Further, as presented in Model 2 and depicted in Figure 4, there was a significant three-way interaction such that change over time in the concurrent association between drug use and RC differed by DTC type (b = −4.27, 95% CI [−7.69, −0.88]). Specifically, the negative concurrent within-person association between drug use (but not alcohol or tobacco use) and RC became significantly different from zero at approximately Wave 3 and became stronger over time for OIC relative to tDTC participants. No other interactions were significant.

3.5 Sensitivity analyses

The pattern of results did not change when (a) only including participants with at least two waves of data and non-zero within-person variability in RC over time (n=142), (b) controlling for between-person differences in the number of waves of data collection completed, or (c) conservatively computing the denominator degrees of freedom based on the number of participants rather than the number of observations. When limiting the operationalization of drug use to be specific to any current opioid use (yes/no), we found that opioid use was negatively associated with RC at both the between- and within-person levels, but the three-way interaction with wave and DTC was nonsignificant.

4. Discussion

This study utilized five waves of data from a one-year longitudinal study of individuals participating in tDTC and OIC to examine within-person trends over time in RC (Aim 1), individual characteristics associated with differences and changes in RC (Aim 2), and patterns of relationships between RC and substance use variables over time (Aim 3). We also explored differences in patterns of associations by DTC type. Three major findings emerged. First, OIC participants had lower RC at baseline relative to tDTC participants, and there was considerable within-person variability in RC over time. Second, the effect of a high school diploma/GED at baseline on RC change over time was greater for OIC relative to tDTC participants. Third, there was a negative concurrent within-person association between drug use and RC that became stronger over time for OIC relative to tDTC participants.

4.1 Longitudinal trajectories in RC

In line with expectations, OIC participants had lower baseline RC relative to tDTC participants. This finding demonstrates a continued need for OICs' more intensive interventional approach for individuals with OUD. The number of people in the U.S. meeting criteria for OUD increased to 5.6 million in 2021 (SAMHSA, 2022), and DTCs have seen a corresponding increase in the percentage of their clients presenting with OUD (Matusow et al., 2013). Accumulating evidence indicates that individuals with OUD need more RC than what tDTCs typically provide, given their lower RC early in recovery (Kelly et al., 2018) and lower likelihood of graduating from tDTC (Gallagher et al., 2018) compared to individuals without OUD. Providing high-risk individuals with OUD the option of OIC participation, with its immediate linkage to treatment and services such as MOUD, seems critical in continuing to address the U.S. opioid epidemic (Kahn et al., 2021). More broadly, understanding differential RC levels could help triage treatment, such that individuals with lower RC receive more intensive efforts to build RC than individuals with pre-existing higher levels.

To our knowledge, this study is the first to go beyond between-person differences in cross-sectional RC to quantitatively examine longitudinal, within-person trajectories in RC across multiple timepoints. One previous investigation utilizing a pre-post design found no change in RC among recovery community center attendees (Kelly et al., 2021), whereas other pre-post studies have found improvements in RC among OUD outpatients (Lynch et al., 2021) and individuals with a history of incarceration (Bormann, Weber, Miskle, et al., 2023). Consistent with Kelly et al. (2021), the current analyses revealed a lack of systematic linear change in RC across five timepoints, but a considerable proportion of the overall variance in RC (46%) was at the within-person level. As depicted in Figure 2, there was between-person heterogeneity in within-person RC trajectories which likely contributed to the lack of an overall linear trend: some individuals exhibited decreases in RC, others showed stable or increasing RC, and still others demonstrated fluctuations between higher and lower RC over time. As such, in line with theories positing that RC is dynamic (Cleveland et al., 2021), there was important within-person variability in RC across timepoints. Capturing and understanding this within-person RC variability was not possible in previous studies investigating RC as a static, between-person trait. Future research should continue to explore how RC changes over time and in relation to different conditions and contexts.

4.2 Sociodemographic predictors of RC

One factor in the current investigation that was linked to between-person differences in within-person RC trajectories was education level, at least for OIC participants. No other associations were significant, suggesting that when all other sociodemographic predictors were considered, a high school diploma or GED at baseline was the individual difference factor most strongly related to improvements in RC over time for OIC participants. These findings support and extend prior research indicating that individuals draw upon educational experiences to assist their recovery (Cloud & Granfield, 2001), and that education had the greatest impact on graduating from DTC (Gill, 2016). Our findings additionally suggest that a high school diploma/GED may be key for OIC clients to accumulate greater RC over time, even after they have graduated from DTC. Importantly, OIC clients had lower initial RC than tDTC clients, and thus more room for improvement. Nonetheless, a high school diploma/GED at baseline may be especially important for capitalizing on the immediate linkages to treatment and resources that OICs provide to gain additional RC over time in recovery. DTCs may want to consider offering more resources to assist participants in obtaining a GED or further education early in the program (Gallagher et al., 2018).

4.3 Associations between substance use variables and RC

Both alcohol and drug use were concurrently negatively associated with RC within-persons, but only the association between drug use and RC became stronger over time for OIC participants. These results partially align with previous findings indicating a concurrent negative association between RC and alcohol use post-incarceration (Bormann, Weber, Miskle, et al., 2023) and during OUD treatment (Bormann, Weber, Arndt, et al., 2023). However, findings from this study also advance theoretical and empirical RC literature to suggest that associations between substance use and RC change over time. SUD recovery is an ongoing process that requires sustained efforts to reduce problematic substance use and accumulate RC (Cleveland et al., 2021). Especially for OIC clients who engaged in more frequent drug use (74% of reports) compared to tDTC clients (36% of reports), initial reductions in drug use may not be linked to immediate gains in RC; instead, it may take several months of sustaining reductions in drug use among this high-risk group before meaningful gains in RC can be seen.

Results from this study suggest that service providers and other professionals should not only link clients to RC in the short-term, but also maintain contact and promote continued access to RC. Our findings demonstrate that individuals' access to RC is not static. Instead, RC changes dynamically over time for many individuals, and therefore presents a malleable protective factor that coincides with reductions in drug use in the longer-term. Indeed, in these analyses, the negative concurrent within-person association between drug use and RC for the OIC group did not become significantly different from zero until approximately Wave 3 (i.e., 6-month follow-up), which is considered the benchmark for retention in OUD pharmacotherapy (National Quality Forum, 2017). Further, we found that a high school diploma/GED is an important individual difference factor linked to greater increases in RC over time among OIC clients. By providing sustained support and connections to treatment and other services, and targeting the individuals who need them most (e.g., individuals without a high school diploma/GED), OIC may help clients on the path to reduced drug use and recovery.

Of note, sensitivity analyses indicated that opioid use specially, rather than drug use generally, was also concurrently negatively associated with RC within-persons, but the three-way interaction with wave and DTC was nonsignificant. The greater prevalence of any drug use relative to opioid use in both the tDTC and OIC groups may have increased power to detect differences in mean change over time. Future studies should more closely investigate relationships between RC and use of specific drug types.

4.4 Limitations and future directions

Although there are guiding principles for DTC, each may be influenced by factors not examined in these analyses, such as the specific attitudes of the judges and court staff. These data were not from a randomized controlled trial, and the participants of the two distinct DTC types were different from one another in several ways. We also did not have a control group of non-DTC participants. Although care was taken to account for potentially confounding sociodemographic characteristics, this approach is not a substitute for randomization or prospective matching, and any differences observed in RC cannot necessarily be attributed to the DTC type of the participants or their DTC experience more broadly. Future research is needed to systematically evaluate DTC differences on issues such as rates of re-arrest and incarceration and MOUD initiation over time, as well as links to RC and substance use. Additionally, there were missing data that were treated using listwise deletion, which may have impacted parameter estimates. Finally, composite BARC scores may have obscured heterogeneity in the timing or rate of change of individual RC items. Future research examining RC items separately could elucidate which domains of RC to target with early intervention.

5. Conclusions

This study makes a novel contribution to the RC literature by examining longitudinal, within-person trajectories in RC across multiple timepoints. Results revealed important within-person variability in RC that was linked to education and drug use over time, particularly among OIC clients. Findings could help inform tailored treatment approaches in DTCs and other substance use treatment settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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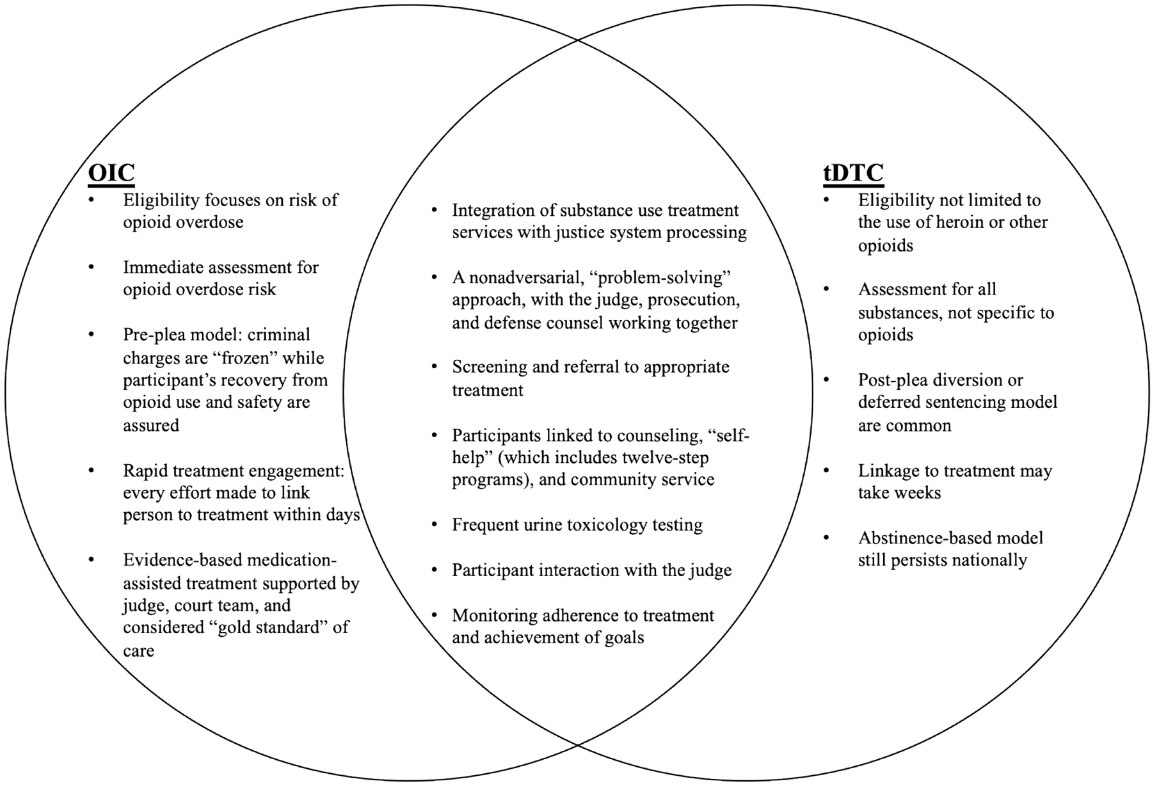

Figure 1.
Characteristics of Opioid Intervention Court (OIC) and traditional Drug Treatment Court (tDTC).

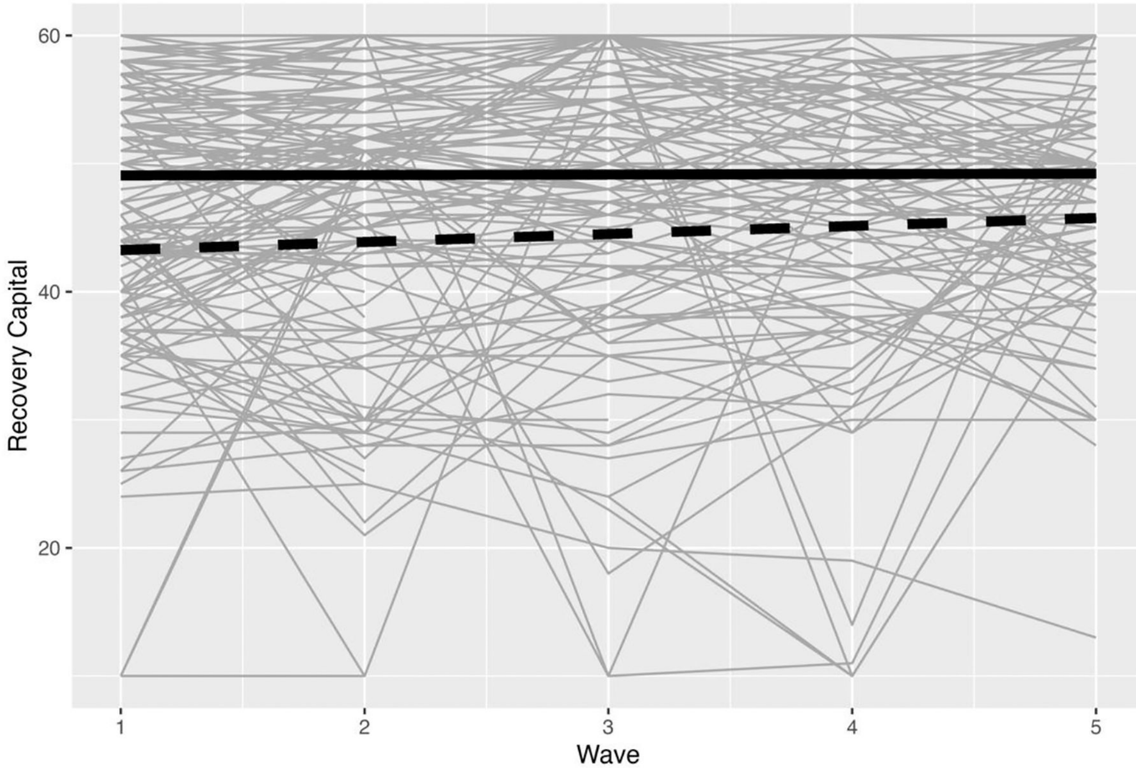

Figure 2.
Within-person trajectories in recovery capital over time.

Note. Gray lines represent person-specific trajectories in recovery capital over time. Solid line = Average slope for traditional drug treatment court (tDTC) participants. Dotted line = Average slope for opioid intervention court (OIC) participants. Average slopes are estimated from Model 2 in Table 4.

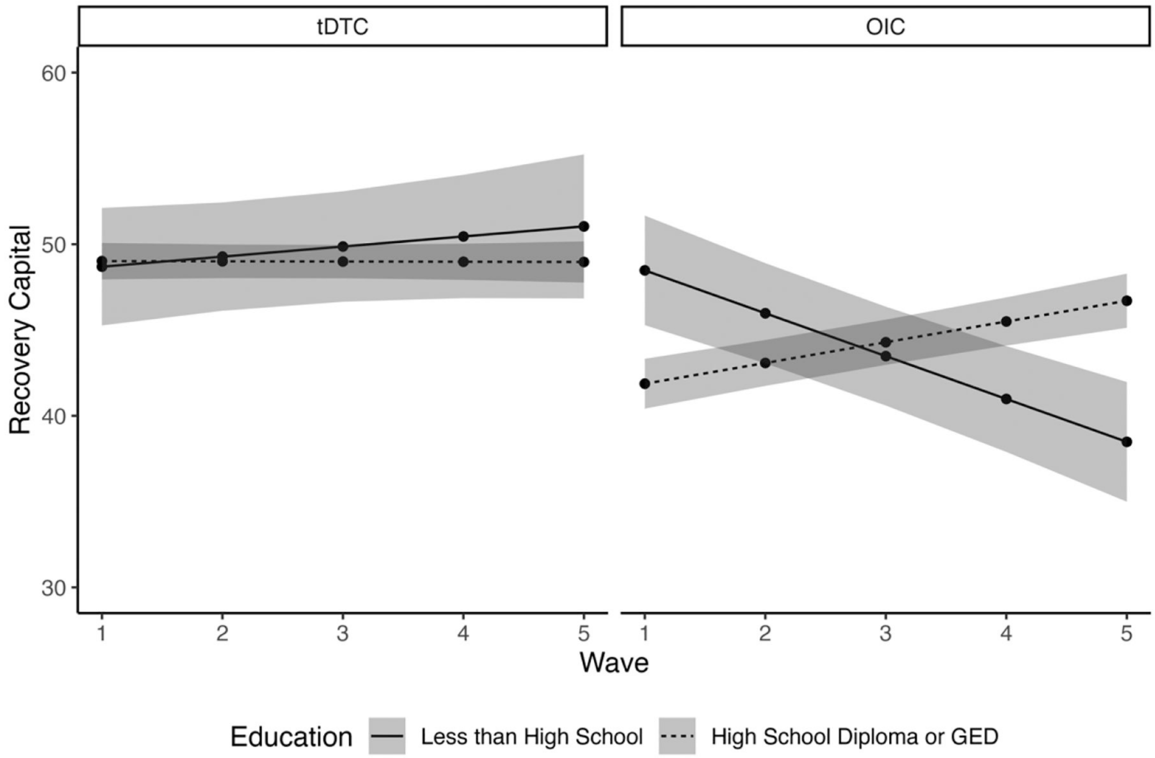

Figure 3.

Associations between education and recovery capital over time, separately by drug treatment court type.

Note. The effect of a high school diploma/GED at baseline on recovery capital change over time was greater for OIC relative to tDTC participants. OIC participants with a high school diploma/GED at baseline exhibited greater positive linear mean change in recovery capital over time on average relative to OIC participants without a high school diploma/GED at baseline, a pattern that was not observed for tDTC participants. Slopes are estimated from Model 2 in Table 5.

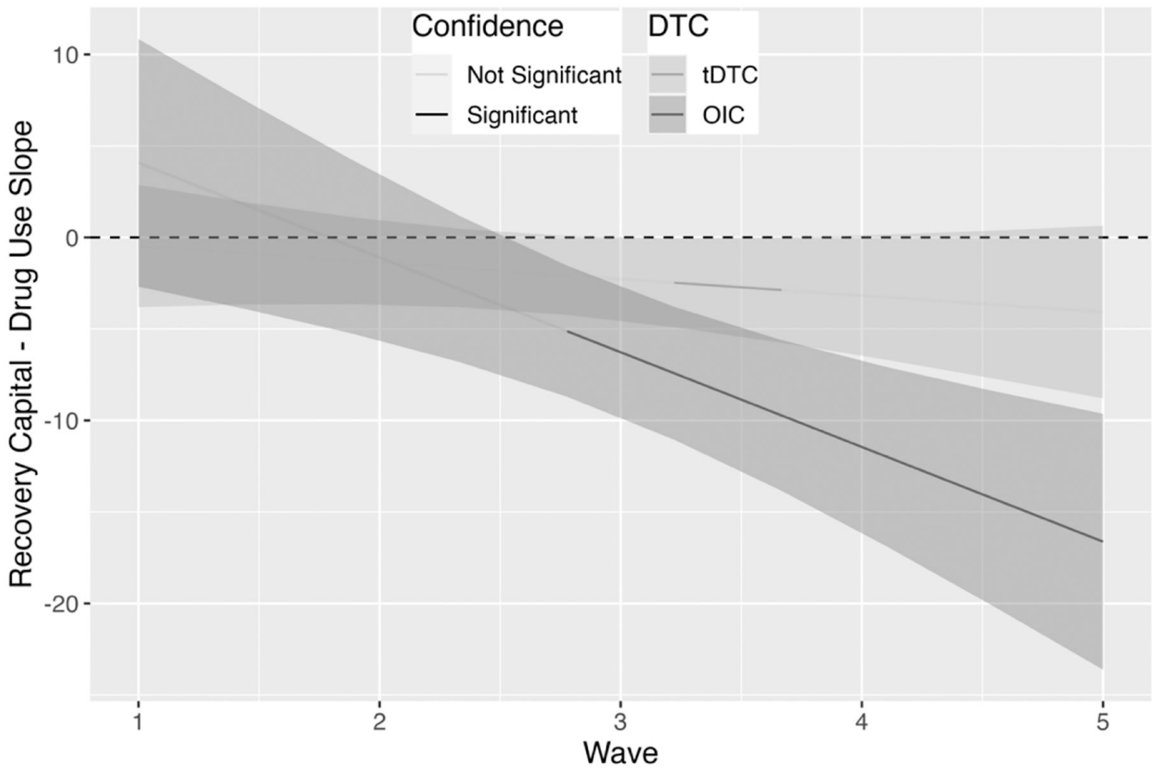

Figure 4.

Within-person association between drug use and recovery capital over time, separately by drug treatment court type.

Note. Marginal effects estimated for wave's drug use. The negative concurrent within-person association between drug use and recovery capital became significant around Wave 3 and became stronger over time for OIC relative to tDTC participants. Slopes are estimated from Model 2 in Table 6.

Table 1.

Sample demographics.

	Mean (SD) / Frequency (%)	
Characteristic	**tDTC**	**OIC**
N	104	61
Age	38.08 (10.76)	34.49 (7.09)
Gender		
Male	59 (56.7)	27 (44.3)
Female	45 (43.3)	33 (54.1)
Other	0 (0.0)	1 (1.6)
Ethnicity		
Non-Hispanic	100 (96.2)	51 (83.6)
Hispanic	4 (3.8)	10 (16.4)
Race		
American Indian or Alaska Native	3 (2.9)	2 (3.3)
Asian	0 (0.0)	0 (0.0)
Black or African American	16 (15.4)	2 (3.3)
Native Hawaiian or other Pacific Islander	0 (0.0)	0 (0.0)
White	79 (76.0)	51 (83.6)
Other	6 (5.8)	6 (9.8)
Relationship status		
Married	10 (9.6)	1 (1.6)
Living with someone as if married	3 (2.9)	20 (32.8)
Separated	7 (6.7)	3 (4.9)
Divorced	11 (10.6)	2 (3.3)
Widowed	1 (1.0)	1 (1.6)
Single and have never been married	72 (69.2)	34 (55.7)
Education		
Less than high school	9 (8.7)	10 (16.4)
High school diploma or GED	43 (41.3)	20 (32.8)
Trade school	9 (8.7)	0 (0.0)
Some college (no degree)	25 (24.0)	20 (32.8)
Completed Associate or other Technical 2-year degree	11 (10.6)	8 (13.1)
Completed Bachelor's or other 4-year degree program	4 (3.8)	2 (3.3)
Some Graduate or Professional studies	0 (0.0)	0 (0.0)
Completed Graduate or Professional degree	2 (1.9)	1 (1.6)
Other	1 (1.0)	0 (0.0)
Employment		
Full-time	24 (23.1)	3 (4.9)
Part-time	15 (14.4)	9 (14.8)
Not currently employed	65 (62.5)	49 (80.3)

	Mean (SD) / Frequency (%)	
Characteristic	**tDTC**	**OIC**
Total Annual Household Income		
Less than $19,999	44 (42.3)	30 (49.2)
$20,000 to $39,999	17 (16.3)	12 (19.7)
$40,000 to $59,999	6 (5.8)	1 (1.6)
$60,000 to $79,999	3 (2.9)	1 (1.6)
$80,000 to $99,999	2 (1.9)	0 (0.0)
$100,000 to $119,999	1 (1.0)	0 (0.0)
$120,000 or more	2 (1.9)	2 (3.3)
Don't know	26 (25.0)	11 (18.0)
Refused	3 (2.9)	4 (6.6)
Drug use		
Prescription stimulants	0.17 (0.28)	0.16 (0.23)
Sedatives or sleeping pills	0.21 (0.28)	0.37 (0.36)
Prescription pain medications	0.28 (0.31)	0.48 (0.33)
Other prescription drugs	0.13 (0.24)	0.09 (0.14)
Cannabis	0.42 (0.31)	0.57 (0.35)
Cocaine	0.30 (0.28)	0.54 (0.34)
Methamphetamine	0.18 (0.25)	0.32 (0.35)
Inhalants	0.09 (0.22)	0.06 (0.11)
Hallucinogens	0.21 (0.29)	0.25 (0.27)
Street opioids	0.18 (0.24)	0.55 (0.36)
Other illicit drugs	0.04 (0.15)	0.09 (0.18)

Note. Questions about prescription drug use specifically asked about nonmedical use. Means for drug use variables indicate the proportion of timepoints that use of the drug was reported across all persons and waves.

Table 2.

Descriptive statistics for all study variables, for the total sample and separately by drug treatment court.

	Total Sample (*n*=165)					tDTC (*n*=104)					OIC (*n*=61)				
Variable	***M***	***WP SD***	***BP SD***	**Range**	**ICC**	***M***	***WP SD***	***BP SD***	**Range**	**ICC**	***M***	***WP SD***	***BP SD***	**Range**	**ICC**
RC	47.03	5.37	9.22	10–60	0.54	49.09*	4.62	8.54	10–60	0.58	43.52*	6.53	9.34	10–60	0.45
Drug	0.50	0.24	0.41	0 – 1	0.49	0.36*	0.30	0.36	0 – 1	0.28	0.74*	0.15	0.37	0 – 1	0.56
Tobacco	0.81	0.10	0.35	0 – 1	0.68	0.77*	0.12	0.38	0 – 1	0.69	0.88*	0.07	0.28	0 – 1	0.61
Alcohol	0.14	0.13	0.28	0 – 1	0.44	0.17*	0.17	0.30	0 – 1	0.38	0.09*	0.07	0.24	0 – 1	0.57

Note. M = Mean. WP = Within-person. BP = Between-person. SD = Standard deviation. ICC = Intraclass correlation coefficient. tDTC = Traditional drug treatment court. OIC = Opioid intervention court. RC = Recovery capital.

* = Means are significantly different between tDTC and OIC.

Recovery capital means indicate the level of recovery capital across all persons and waves. Means for drug, tobacco, and alcohol use variables indicate the proportion of timepoints that drug, tobacco, and alcohol use were reported across all persons and waves.

Table 3.

Correlations among recovery capital and substance use variables.

Within-person									
	Total Sample			tDTC			OIC		
Variable	**RC**	**Drugs**	**Tobacco**	**RC**	**Drugs**	**Tobacco**	**RC**	**Drugs**	**Tobacco**
Drugs	−0.17			−0.13			−0.24		
Tobacco	−0.01	0.00		−0.01	−0.02		0.00	0.04	
Alcohol	−0.09	0.08	0.01	−0.04	0.06	0.01	−0.19	0.12	0.01
Between-person									
	Total Sample			tDTC			OIC		
Variable	**RC**	**Drugs**	**Tobacco**	**RC**	**Drugs**	**Tobacco**	**RC**	**Drugs**	**Tobacco**
Drugs	−0.18			0.12			−0.29		
Tobacco	−0.13	0.29		0.00	0.24		−0.28	0.24	
Alcohol	−0.12	−0.04	0.00	−0.18	0.04	0.02	−0.20	0.08	0.11

Note. RC = Recovery capital. tDTC = Traditional drug treatment court. OIC = Opioid intervention court.

Table 4.

Linear trends in recovery capital over time.

	Model 1				Model 2			
Fixed Effects	**Est**	**SE**	***p***	**95% CI**	**Est**	**SE**	***p***	**95% CI**
Intercept	46.65	0.80	<.0001	45.10, 48.21	49.04	0.96	<.0001	47.17, 50.90
Wave number	0.25	0.22	0.2680	−0.19, 0.69	0.03	0.29	0.9040	−0.53, 0.60
DTC					−6.41	1.57	<.0001	−9.47, −3.32
Wave number × DTC					0.59	0.46	0.1980	−0.32, 1.49
Random Effects	**Est**			**95% CI**	**Est**			**95% CI**
Intercept SD	8.32			6.96, 9.63	7.75			6.39, 9.00
Wave number slope SD	0.69			−0.20, 1.58	0.66			−0.25, 1.53
Intercept, Wave number slope correlation	−0.26			−1.45, 0.93	−0.12			−1.40, 1.09
Residual SD	7.33			6.87, 7.87	7.33			6.88, 7.88
R-square	**Est**				**Est**			
Marginal pseudo-R^2	0.001				0.06			
Conditional pseudo-R^2	0.55				0.56			

Note. Est = Estimate. SE = Standard error. CI = Confidence interval. DTC = Drug treatment court. SD = Standard deviation. $N_{persons}$ = 165; N_{waves} = 645. DTC is coded such that 0=Traditional treatment court, 1=Opioid intervention court.

Table 5.

Sociodemographic factors' associations with recovery capital levels and mean change over time.

	Model 1				Model 2			
Fixed Effects	**Est**	**SE**	***p***	**95% CI**	**Est**	**SE**	***p***	**95% CI**
Intercept	48.43	2.51	<.0001	43.57, 53.30	48.03	3.67	<.0001	40.94, 55.29
Age	−0.01	0.07	0.9343	−0.15, 0.14	−0.002	0.08	0.9817	−0.15, 0.15
Female	0.30	1.45	0.8360	−2.58, 3.15	0.21	1.46	0.8874	−2.69, 3.06
Employed	1.98	1.55	0.2053	−1.07, 5.08	2.04	1.58	0.1993	−1.06, 5.20
Married	0.24	1.78	0.8951	−3.29, 3.71	0.16	1.79	0.9273	−3.37, 3.65
HS education	−0.48	2.27	0.8341	−4.90, 3.97	0.33	3.61	0.9281	−6.83, 7.33
Non-Hispanic White	−0.15	1.66	0.9279	−3.40, 3.11	−0.11	1.69	0.9497	−3.42, 3.19
DTC	−5.19	1.56	0.0011	−8.29, −2.13	−0.21	4.68	0.9635	−9.48, 8.85
Wave number	0.26	0.22	0.2333	−0.17, 0.69	0.59	1.04	0.5718	−1.49, 2.63
Wave number×HS education					−0.60	1.08	0.5781	−2.71, 1.56
DTC×HS education					−6.93	5.07	0.1728	−16.76, 3.13
Wave number×DTC					−3.09	1.34	0.0218	−5.73, −0.44
Wave number×DTC×HS education					4.31	1.42	0.0026	1.48, 7.11
Random Effects	**Est**			**95% CI**	**Est**			**95% CI**
Intercept SD	7.82			6.66, 8.87	7.87			6.67, 8.89
Residual SD	7.44			6.98, 7.93	7.33			6.89, 7.82
R-square	**Est**				**Est**			
Marginal pseudo-R^2	0.06				0.07			
Conditional pseudo-R^2	0.55				0.57			

Note. Est = Estimate. SE = Standard error. CI = Confidence interval. DTC = Drug treatment court. SD = Standard deviation. $N_{persons}$ = 163; N_{waves} = 638. All interactions among (a) DTC and sociodemographic factors, and (b) wave number and sociodemographic factors were tested; only significant interactions were retained in final model. The Wave number×DTC×HS education parameter remained significant in a reduced model which only included wave number, DTC, HS education, and their interaction.

Table 6.

Concurrent associations between substance use variables and recovery capital levels and mean change over time.

	Model 1				Model 2			
Fixed Effects	**Est**	**SE**	***p***	**95% CI**	**Est**	**SE**	***p***	**95% CI**
Intercept	48.60	3.30	<.0001	42.08, 55.09	48.53	3.27	<0.0001	42.14, 54.98
HS education	1.04	3.46	0.7649	−5.74, 7.87	1.02	3.42	0.7663	−5.74, 7.71
DTC	−0.32	4.55	0.9443	−9.27, 8.70	0.15	4.50	0.9741	−8.73, 8.95
Wave number	0.24	1.03	0.8171	−1.80, 2.26	0.31	1.03	0.7639	−1.72, 2.32
Wave number×HS education	−0.53	1.06	0.6201	−2.62, 1.59	−0.54	1.06	0.6133	−2.62, 1.56
DTC×HS education	−7.69	4.81	0.1111	−17.25, 1.76	−8.49	4.77	0.0769	−17.83, 0.94
Wave number×DTC	−2.59	1.32	0.0505	−5.21, 0.05	−2.80	1.33	0.0377	−5.41, −0.17
Wave number×DTC×HS education	3.98	1.40	0.0047	1.16, 6.76	4.15	1.41	0.0040	1.36, 6.92
PM drug use	−0.10	1.99	0.9587	−4.00, 3.90	0.20	1.99	0.9186	−3.64, 4.10
PM tobacco use	−1.91	2.08	0.3600	−5.97, 2.13	−2.00	2.09	0.3388	−6.12, 2.10
PM alcohol use	−4.41	2.55	0.0857	−9.41, 0.57	−4.10	2.55	0.1104	−9.09, 0.96
Wave's drug use	−2.95	0.93	0.0016	−4.75, −1.17	−0.47	1.69	0.7804	−3.76, 2.85
Wave's tobacco use	0.45	1.48	0.7594	−2.48, 3.39	0.32	1.46	0.8268	−2.56, 3.18
Wave's alcohol use	−3.94	1.33	0.0032	−6.52, −1.31	−3.73	1.32	0.0048	−6.31, −1.12
Wave number×Wave's drug use					−0.90	0.86	0.2942	−2.61, 0.78
DTC×Wave's drug use					4.55	3.81	0.2338	−2.96, 12.10
Wave number×DTC×Wave's drug use					−4.27	1.72	0.0134	−7.69, −0.88

Random Effects	**Est**	**95% CI**	**Est**	**95% CI**
Intercept SD	7.74	6.56, 8.73	7.69	6.17, 8.79
Wave number slope SD	NA	NA	0.44	−0.63, 1.07
Intercept, Wave number slope correlation	NA	NA	0.11	−1.08, 1.42
Residual SD	7.20	6.77, 7.68	7.06	6.67, 7.65

R-square	**Est**	**Est**
Marginal pseudo-R^2	0.10	0.11
Conditional pseudo-R^2	0.58	0.60

Note. Est = Estimate. SE = Standard error. CI = Confidence interval. DTC = Drug treatment court. PM = Person-mean. SD = Standard deviation. $N_{persons}$ = 164; N_{waves} = 640. All interactions among (a) DTC and wave's drug/tobacco/alcohol use, and (b) wave number and wave's drug/tobacco/alcohol use were tested; only significant interactions were retained in final model. The random slope for wave number in Model 1 resulted in a variance estimate that was very near zero, and as such, it was removed from the final model.