**Substance use treatment completion and criminal justice system contact in Chile: A retrospective, linked data, cohort study.**

# Abstract

**Aim:** To examine the association between substance use treatment (SUT) completion and subsequent criminal justice system (CJS) contact at 1-, 3-, and 5 years post-discharge.

**Design:** Retrospective cohort study using multivariate survival analysis based on linked data from the Chilean national drug agency and the Prosecutor’s Office records from 2010 to 2019.

**Setting** SUT is available at no cost through Chile’s publicly funded healthcare and is provided in outpatient and residential modalities in public and private centres.

**Participants:** A total of 70,854 individuals received their first SUT from 2010 to 2019 (27.20% completed treatment).

**Measurements:** SUT completion status included completion, late dropout (>=3 months) and early dropout (<3 months). Primary outcomes were (1) any CJS contact and (2) contact leading to imprisonment after baseline treatment. We estimated the association treatment completion and CJS contact through Royston-Parmar models while adjusting for several covariates, obtaining standardised survival curves and restricted mean survival times (RMST) at 1-, 3-, and 5 years post-discharge.

**Findings:** Results showed that 31.4% of the participants had CJS contact after exiting their first SUT episode during the observed period, and 7.3% had CJS contact leading to imprisonment. Those who completed SUT were more likely [73.4%; 95% confidence interval (CI)= 72.7, 74.2] to avoid any CJS contact for the five years following completion, than those who dropped out late (63.9%, 95% CI = 63.4, 64.5) and early (62.2%, 95% CI = 61.4, 63.1). These differences were also observed at 1 and 3 years.

**Conclusions** SUT completion was associated with a substantial reduction in CJS contact and imprisonment up to 5 years after the first SUT episode.

**Key terms:** Substance use treatment completion; Survival analysis; Contact with the criminal justice system; Imprisonment.

**Words number: 3,480**

# INTRODUCTION

The association between substance use and offending is well-documented (1). Evidence shows that a substantial proportion (40-60%) of individuals presenting to substance use treatment (SUT) also self-report recent offending (2, 3). Substance use can lead to offending through several mechanisms, such as lowering inhibitions and generating the urgent need to finance the substance use habit, even through illegal means. Furthermore, being in contact with the drug market to obtain substances can also create opportunities for engaging in criminal activities (4). Nevertheless, the substance use-offending relationship might also be reciprocal, as it has been reported that substance use can be an obstacle to desistence from crime, and at the same time, criminal involvement and criminal networks can hinder substance use recovery (3, 5). These considerations make it reasonable to expect that decreasing problematic patterns of substance use with SUT may reduce offending and criminal justice system (CJS) contact.

Treating substance use disorders is difficult as relapse experiences are common (1). Moreover, individuals usually experience trouble adhering to treatment (6-9). Also, approximately 30% of people drop out of treatment (7), which is concerning given this is associated with poorer health and offending outcomes (8, 10-12).

Despite the demonstrated effectiveness of SUT in reducing offending, and therefore, in the demand on the CJS and the victim costs of crime (3, 5, 12-17), the role of SUT completion for offending reduction has been underexplored (3, 15, 18). According to the US National Institute on Drug Abuse (19), treatment that lasts less than 90 days has limited effectiveness, calling for longer treatments. However, capturing the duration of treatment might not be as informative as treatment completion because it indicates when a patient achieves the goals of treatment prescribed by professional advice (18). Evidence from Finland shows that discontinued inpatient SUT episodes were more likely to be followed by offending, leading to imprisonment during a 5-year follow-up period, compared with completed treatment periods (15). Similarly, the literature on drug courts has documented that SUT non-completion was associated with higher offending (20-22).

Both individual characteristics (sex, age, type of substance consumed, substance use patterns and profile, socioeconomic disadvantage, mental health problems, prior exposure to treatment, offending history, childhood trauma) and treatment features (setting, location, among others) have an impact on the likelihood of completing SUT (6-9, 18, 23-31) and on subsequent offending (3, 12, 13, 15, 17, 18, 32, 33). Therefore, it is important to control for these factors such as these when examining the association between SUT and subsequent offending.

While all cited studies have significantly contributed to our knowledge, most of them come from developed Western countries and regions (e.g., the US, and Western Europe), and other contexts are relatively under-explored (34, 35). The Chilean SUT policy is an interesting case study as it is one of Latin America's oldest and most developed SUT systems. It is one of the few countries in the region with a centralised data registry system that allows the examination of local data (35-37). Among the several ways to measure offending, CJS contact is considered rigorous because, unlike self-report offending, it is based on administrative records and thus avoids problems of recall, overstatement, or concealment of offending (14). Studying SUT outcomes in the Chilean context can contribute to the research gap in terms of SUT completion on offending outcomes and address the limited research on addiction from the Global South. Additionally, scholars have called for further research on SUT effectiveness from longitudinal, large-scale population and system-level treatment, and studies using observational data (11, 38, 39). Hence, the current research aims to address those gaps by exploring the association between SUT completion with subsequent CJS contact in Chile, examining both ‘any’ contact and contact leading to imprisonment after 1, 3 and 5 years of follow-up, using a longitudinal, linked administrative data of individuals who received SUT treatment from 2010 to 2019.

# METHOD

# Design

This research relies on a retrospective cohort design using novel linked data from two sources of administrative records (2010-2019). Records were extracted for all individuals enrolled in publicly funded adult SUT at the Chilean Service for Prevention and Rehabilitation of Drug and Alcohol Consumption (SENDA). Secondly, Prosecutor’s Office data were extracted and matched for all individuals in the SUT sample, which included data on official criminal charge records (finalised court outcomes only). We conducted a deterministic linkage process by using an encrypted version of the Chilean Unique National Identification Number, which is assigned to all Chilean residents. A third-party agency performed the encryption of the participants’ identification numbers to maintain confidentiality. This research protocol was approved by the Griffith University Human Research Ethics Committee (GU Ref No: 2022/919).

**Setting and participants**

SUT is voluntary and available at no cost for patients through Chilean’s publicly funded healthcare (∼80% of the population eligible), with around 30,000 yearly admissions. There are multiple SUT providers in Chile, with both public (coverage ∼71%) and private (∼29%) financed by the Chilean State through a bidding process that requires them to follow technical protocols for quality assurance. SUT includes outpatient (∼85%) and residential (∼15%) treatment settings, and treatment is tailored for specific sub-groups, such as gender-specific or adolescent populations. This study’s sample includes all programs for the adult population (+18 years), comprising general population and women-specific programs in the outpatient and residential settings hosted by public and private providers.

We identified individuals receiving publicly funded Chilean SUT programs for the adult population between January 2010 to November 2019 (n=85,048). Given that we were interested in the first treatment episode, we excluded from the analysis individuals referred by prior SUT (n=8,657) or with ongoing SUT at the date of information retrieval (November 13th, 2019) (n= 5,521), and those with missing dates of birth (n=7) and without SUT completion status (n=9) (See Supplementary, Section 1). Thus, we selected all individuals enrolled in their first publicly funded Chilean SUT programs for the adult population from January 2010 to November 2019 (n=70,854).

## Measures

*SUT completion status (Exposure variable)*

Completion status was categorised using the dates of admission and exit from their first SUT (or baseline) and the information regarding reasons for discharge from SUT. This variable was categorised into: SUT completion, late dropout (>= 3 months of SUT), and early dropout (<3 months). Early and late dropout can be due to voluntary or involuntary causes (e.g., interruptions due to conduct against treatment norms).

*CJS contact (Outcome 1)*

Time was coded in years and calculated as the difference between the age when the offence was committed and the age of the exit date from the first SUT episode. We defined CJS *‘contact’* as any offence determined by a finalised court outcome that was either (1) adjudicated with a guilty verdict (ranging from fines to imprisonment) or (2) diverted from further proceedings (a Chilean legal ruling that translates to Conditional Suspensions of Proceedings), according to the Chilean Prosecutor’s Office records from 2010 to 2019. Hence, we are not considering the acquitted outcome as *‘contact’*. However, we considered diverted outcomes (2) as ‘contact’ because it represents the CJS response to individuals that committed -for the first time - crimes that are viewed as less serious. If more than one contact was recorded on the same date, we considered only the first one.

*CJS contact leading to imprisonment (Outcome 2)*

Time was coded in years (continuous time) and calculated as the difference between the age when the offence leading to imprisonment was committed and the age of the exit date from the first SUT episode SUT, according to official records from 2010 to 2019.

*Other covariates*

Covariates for the regression analyses covered four domains. First, demographic information: sex, age (we transformed this variable into a restricted cubic spline variable with knots due to nonlinearity), poverty of the municipality of residence, urbanicity of the county of residence, employment, education, tenure status of household, having children, and cohabitation. Second, treatment level factors: modality of treatment, geographical area, and year of SUT admission. Third, health information: substance use onset age, type of substance use at onset, substance use severity, primary substance at admission, frequency of use of primary substance at admission, poly-substance use, psychiatric comorbidity, and severe physical comorbidity. And finally, pre-treatment criminal history: number of previous violent, acquisitive, drug-related, and other offences.

## Statistical analysis

*Survival analysis*

We aimed to estimate the association between the SUT completion status and CJS contact (Outcomes 1 and 2). A model specification analysis focused on testing the assumption of proportional hazards was performed. As hazards were not proportional in both models, we calculated the association between SUT completion status and CJS contact through Royston-Parmar models while adjusting for the aforementioned covariates. Models were evaluated over the entire follow-up period, and the degrees of freedom of restricted cubic splines of the baseline log hazard functions, and time-varying coefficients were determined using the Akaike information criterion for model fit and the Bayesian information criterion for parsimony. Additionally, we obtained the standardised survival curves and restricted mean survival times (RMST) and their differences between treatment completion status at 56 equally spaced times between 0 and 7, but focused on 1, 3 and 5 years through the *stpm2* command in Stata (See Supplementary, Section 2) (40-42). Missing data (reported in Table 1) were imputed using multiple imputations with regression trees from *missRanger* R package(43).

*Sensitivity Analysis*

We estimated the E-values to explore the minimum strength of an unmeasured confounder needed to explain away the association between SUT completion and CJS contact. To estimate E-values while accounting for non-proportional hazards, average hazard ratios (aHR) from multivariable weighted Cox analyses were calculated (44). Also, we tested the sensitivity of our results to missing data bias, so we compared different models: (i) using complete cases (no imputation) and (ii) imputing missing data with the “under study” unknown physical and psychiatric comorbidity given that we suspected informative missingness (i.e., people with shorter treatment lengths would have less comorbidity information). These analyses are included in Supplementary, Section 3. Codes for all analyses are available at bit.ly/40cMATs.

# RESULTS

**Characteristics of the study sample**

The sample included 70,854 individuals that received their first SUT from 2010 to 2019. Among the sample, 19,276 individuals (27.2%) achieved SUT completion, 35,781 individuals (50.5%) had a late dropout, and 15,797 individuals (22.3%) had an early dropout. In terms of the covariates, individuals who completed treatment had different baseline characteristics vs. those who dropped out. The main demographic differences between those individuals who completed treatment vs. those who dropped out were that they were older, less frequently unemployed, and attained higher education. In terms of substance use type, those who completed treatment were more likely to declare alcohol as the main substance rather than cocaine paste. Those who completed were also less likely to develop substance use dependence, engage in polysubstance use, and use substances less frequently. Furthermore, comorbidity (psychiatric or physical) was more frequently diagnosed in people who completed treatment (See a detailed analysis of this variable in Supplementary, Section 3). Finally, individuals who completed treatment were less likely to have a history of criminal offences pre-treatment of any kind. Participant characteristics are displayed in Table 1.

[Insert Table 1 here]

**Proportion of CJS contact**

When examining CJS contact post-SUT in terms of proportions and incidence rates (accounting that follow-up times differed between people), 22,287 individuals (31.5%, and 97 per 1,000 person-years) had at least one CJS contact, and 5,144 (7.3%, and 17 per 1,000 person-years) had contact leading to imprisonment. Notably, the group that completed treatment had fewer subsequent CJS contacts (19.8%) than the group who dropped out of treatment late (34.4%) and early (38.8%). Likewise, the group that completed treatment had significantly fewer (3.4%) contacts leading to imprisonment than the group that dropped out of treatment late (7.7%) or early (10.8%).

**Association between SUT completion and CJS contact: any contact and contact leading to imprisonment.**

Given the survival analysis framework, the following results examine the time until the ‘event’ (i.e., CJS contact) at 1, 3 and 5 years after exiting the first SUT, in two different ways: the probability of ‘survival’ (not experimenting CJS contact or remaining free of CJS contact at a certain time) and the average time until the ‘event’ occurred (RMST).

Firstly, the results show that individuals who completed SUT had higher probabilities of avoiding both any CJS contact (Table 2) as well as contact leading to imprisonment (Table 3) than those who dropped out of SUT (late and early) at 1, 3 and 5 years. These differences become more pronounced over time. Those who completed SUT were more likely (73.4%, 95% CI= 72.7, 74.2) to avoid any CJS contact for the five years following completion, than those who dropped out late (63.9%, 95% CI= 63.4, 64.5) and early (62.2%, 95% CI= 61.4, 63.1). This pattern is also observed in the survival probabilities related to CJS contact that leads to imprisonment.

Secondly, the analysis of the average time until CJS contact occurred provides information on time gap differences between the groups according to SUT completion status. Individuals who completed treatment had the longest average time to CJS contact for both outcomes (any contact and contact leading to imprisonment), followed by those who dropped out late and early from SUT at each time point. For example, 3 years after exiting SUT, individuals who completed SUT took an average of 2.63 years to have any CJS contact, whereas individuals with late SUT dropout took an average of 2.44 years to have CJS contact (two months earlier than those who completed SUT) and people that dropped out early took 2.40 years to have CJS contact (2.5 months earlier than those who completed SUT). Differences are represented graphically in Figure 1, including transition probabilities and differences in RMST.

[Insert Table 2 and Table 3 here]

[Insert Figure 1 here]

**Sensitivity analysis**

We estimated E-values to ensure the robustness of our findings. Thus, an unmeasured confounder would require a hazard ratio of at least 2.10 to explain away the average association between early SUT dropout and any CJS contact (aHR= 1.70 95% CI= 1.59, 1.81). In contrast, an unmeasured confounder of at least 1.93 would explain the association between late dropout and at least one CJS contact (aHR= 1.54 95% CI= 1.46, 1.62). Similarly, an unmeasured confounder would need to be of at least 2.52 to change the association between early dropout and CJS contact leading to imprisonment (aHR= 1.82 95% CI= 1.57, 2.11) to null. And the hazard ratio of an unmeasured confounder would be at least 1.96 to explain away the association between late dropout and having contact leading to imprisonment (aHR= 1.48 95% CI= 1.31, 1.66) (See Supplementary, Section 3).

Our results were robust across different estimations and modelling options. Sensitivity analyses consistently showed equivalent results throughout models with complete cases and imputation of comorbidies in study. Our findings were also corroborated after comparing the results with models estimated by the original and extended Cox regression (See Supplemental Section 4 & 5).

# DISCUSSION

This study assessed the association between SUT completion and CJS contact in Chile over a 5-year follow-up period, with two outcomes: any CJS contact and CJS contact leading to imprisonment. Our findings show that completion of SUT is associated with longer times until CJS contact vs. dropping out of treatment, suggesting that SUT has a protective effect on subsequent CJS contact that is consistent up to 5 years post-treatment. Previous research has shown the association between SUT completion status and subsequent health outcomes, such as mortality and hospitalisations (6, 10, 37, 45, 46). Our findings show that treatment completion is also associated with subsequent CJS contact, consistent with the few studies emphasising the importance of SUT *completion* in the context of the Global North (3, 15). More specifically, the current study supports prior findings showing that completing treatment may prevent any CJS contact or CJS contact leading to imprisonment (15). Preventing CJS contact through SUT also generates positive public health and economic benefits, especially when imprisonment is averted (47).

While previous research has demonstrated the effect of ‘*duration*’ or ‘*length of stay*’ of SUT on CJS involvement outcomes (12-14, 32, 33), we argue that is more informative to measure ‘*completion*’ of SUT. The results presented here deepen our understanding of this field by examining substance use treatment ‘*completion*’, which provides insights regarding the importance of capturing the achievement of individual therapeutic goals as prescribed by professional advice and not necessarily related to longer *‘duration’ or ‘length of stay’* of treatment, as it depends on individual needs (18).

In addition to the importance of completing SUT, our work identified that even having some treatment (late dropout) is related to a lower risk of CJS contact when compared to having almost no treatment (early dropout). Thus, individuals can obtain benefits of SUT even if they do not complete treatment, which might have implications for policymaking in terms of enhancing the practices oriented to treatment retention, related to staff rapport, management of peer misbehaviour, and improvements to program structure (7, 12).

A major strength of our study was the use of novel longitudinal, population-based, linked administrative data from a population-based cohort of SUT patients in Chile. Consequently, our findings are likely to represent SUT users in Chile, which in turn might be relevant for other jurisdictions, particularly regarding the completion of SUT. Using data from over 70,000 individuals gave us the statistical power to assess the association between SUT and CJS contact across groups with varying levels of SUT completion and adjust for several variables. By using the linkage of SUT information and Prosecutor’s office records, we could consider pre-treatment criminality and avoid measures of offending affected by recall, concealment, or overstatement biases.

Notably, the observed findings regarding the protective effect of completing SUT on CJS contact remain significant throughout the various follow-up time points analysed (1, 3, and 5 years). The lack of long-term observations and population-based studies to assess the lasting effect of outcomes of SUT has been a concern in previous research (11, 38, 48). Finding SUT effects after 5 years has important implications for policymakers, as analyses (i.e., cost-benefit) should consider the long-term benefits of SUT on the prevention CJS contact. Another advantage of the current research is that it provides insights outside of the Global North context (34, 35) into the outcomes associated with SUT at a system level (including data from multiple centres and programmes).

However, this research has some limitations. First, we acknowledge the constraints of administrative data; we were unable to control for potential confounding factors, such as history of child maltreatment (12, 30, 49), self-control (3), and motivation to change (30, 33). However, this limitation was mitigated partly by the many social factors adjusted for in the model (50). Secondly, the inability to account for possible unmeasured multiple treatment attempts after the first treatment and before CJS contact might increase the success of the first measured treatment in this study. Third, this research could not consider some sources of left and right censoring, such as pre-treatment criminality information before 2010, receiving adolescent SUT, mortality, and open legal proceedings. Similarly, given that not all offences are reported to the police, and not all of them are prosecuted by the CJS (especially minor offences), the true offending rates are likely to have been underestimated (14, 32). Arguably, offences leading to imprisonment could preclude an individual from incurring any further CJS contact; thus, the risk of both events might be competing. However, these events are only partially because contacts leading to imprisonment only account for a quarter of the general CJS contacts. Another limitation is that standardisation of survival probabilities and RMST often involve assumptions about the data (e.g., no measurement error, independence of observations), which may not fully apply in observational design (40). However, we believe that the sample size, covariates considered, testing of several model specifications in terms of fit to the data, and parsimony may ameliorate these limitations.

Regarding the generalisability of results, using data from Chile seeks to be informative to other countries in Latin America, even though we recognise that the economic and social context can vary within the region. However, we propose that our findings might be more pertinent to the Latin American region than current evidence from the Global North. Finally, this research recognises that the reasons related to offending are multifactorial, and although SUT provides important benefits in terms of health and crime prevention, it is not feasible to expect that SUT by itself can address the broader social issues that lead to offending, including structural factors such as social inequality and drug control legal frameworks (1, 32, 49).

# CONCLUSIONS

Our findings collectively show that SUT is associated with a higher probability of avoiding and longer average time to CJS contact and that its protective effect is optimised when the patients achieve SUT completion. Therefore, an increased focus on encouraging SUT completion is essential to maximise the long-term benefits of SUT. At the same time, our findings show that SUT is an effective diverting alternative from the CJS.

# REFERENCES

1. Best D., Colman C. Strengths-Based Approaches to Crime and Substance Use : From Drugs and Crime to Desistance and Recovery, Milton: Routledge; 2019.

2. Holloway K. R., Bennett T. H., Farrington D. P. The effectiveness of drug treatment programs in reducing criminal behavior: a meta-analysis, Psicothema 2006: 18: 620-629.

3. Skjærvø I., Clausen T., Skurtveit S., Bukten A. Desistance from crime following substance use treatment: the role of treatment retention, social network and self-control. BMC Psychiatry; 2021.

4. Goldstein P. J. The Drugs/Violence Nexus: A Tripartite Conceptual Framework, Journal of Drug Issues 1985: 15: 493-506.

5. Gossop M., Trakada K., Stewart D., Witton J. Reductions in criminal convictions after addiction treatment: 5-year follow-up, Drug and alcohol dependence 2005: 79: 295-302.

6. Andersson H. W., Wenaas M., Nordfjærn T. Relapse after inpatient substance use treatment: A prospective cohort study among users of illicit substances, Addictive Behaviors 2019: 90: 222-228.

7. Lappan S. N., Brown A. W., Hendricks P. S. Dropout rates of in-person psychosocial substance use disorder treatments: a systematic review and meta-analysis, Addiction (Abingdon, England) 2020: 115: 201-217.

8. Morgan C. R., Dennis C. B. Addressing length of stay in substance use treatment to predict successful completion, Journal of Social Work Practice in the Addictions 2022: 1-13.

9. Stafford C., Marrero W. J., Naumann R. B., Lich K. H., Wakeman S., Jalali M. S. Identifying key risk factors for premature discontinuation of opioid use disorder treatment in the United States: A predictive modeling study, Drug and alcohol dependence 2022: 237: 109507.

10. Ruiz-Tagle Maturana J. M., González Santa-Cruz A., Rocha-Jiménez T., Castillo-Carniglia Á. DOES SUBSTANCE USE DISORDER TREATMENT COMPLETION REDUCE THE RISK OF TREATMENT READMISSION IN CHILE?, Drug and Alcohol Dependence 2023.

11. Teesson M., Marel C., Darke S., Ross J., Slade T., Burns L. et al. Long-term mortality, remission, criminality and psychiatric comorbidity of heroin dependence: 11-year findings from the Australian Treatment Outcome Study, Addiction 2015: 110: 986-993.

12. Whitten T., Cale J., Nathan S., Hayen A., Williams M., Shanahan M. et al. Duration of stay and rate of subsequent criminal conviction and hospitalisation for substance use among young people admitted to a short-term residential program, Drug and alcohol review 2023.

13. Garnick D. W. S. D., Horgan C. M. S. D., Acevedo A. P. D., Lee M. T. P. D., Panas L. M. S., Ritter G. A. P. D. et al. Criminal justice outcomes after engagement in outpatient substance abuse treatment, Journal of Substance Abuse Treatment 2014: 46: 295-305.

14. Havnes I., Bukten A., Gossop M., Waal H., Stangeland P., Clausen T. Reductions in convictions for violent crime during opioid maintenance treatment: A longitudinal national cohort study, Drug and Alcohol Dependence 2012: 124: 307-310.

15. Kaskela T., Pitkänen T. Association between the discontinuation of substance use inpatient treatment and the risk of committing a crime leading to imprisonment: A Finnish registry-based 5-year follow-up, Criminal Behaviour and Mental Health 2021: 31: 171-182.

16. Prendergast M. L., Podus D., Chang E., Urada D. The effectiveness of drug abuse treatment: a meta-analysis of comparison group studies, Drug and alcohol dependence 2002: 67: 53-72.

17. Smart R., Reuter P. Does heroin-assisted treatment reduce crime? A review of randomized-controlled trials, Addiction 2022: 117: 518-531.

18. Zarkin G. A., Dunlap L. J., Bray J. W., Wechsberg W. M. The effect of treatment completion and length of stay on employment and crime in outpatient drug-free treatment, Journal of substance abuse treatment 2002: 23: 261-271.

19. NIDA. Principles of drug addiction treatment: A research-based guide. NIH: National Institute on Drug Abuse; 2012.

20. Koetzle D. L., S. J. . Drug courts and the criminal justice system: Lynne Rienner Publishers; 2019.

21. Payne J., Australian Institute of C. The Queensland Drug Court : a recidivism study of the first 100 graduates Canberra: Australian Institute of Criminology; 2008.

22. Sheeran A., Knoche V. A., Freiburger T. L. Identifying predictors of drug court graduation: findings from an evaluation of the Milwaukee County Adult Drug Treatment Court, Criminal Justice Studies 2022: 35: 57-73.

23. Brorson H. H., Ajo Arnevik E., Rand-Hendriksen K., Duckert F. Drop-out from addiction treatment: A systematic review of risk factors, Clinical Psychology Review 2013: 33: 1010-1024.

24. Darke S., Campbell G., Popple G. Retention, early dropout and treatment completion among therapeutic community admissions, Drug and Alcohol Review 2012: 31: 64-71.

25. Edelen M. O. P. D., Tucker J. S. P. D., Wenzel S. L. P. D., Paddock S. M. P. D., Ebener P. B. A., Dahl J. P. D. et al. Treatment process in the therapeutic community: Associations with retention and outcomes among adolescent residential clients, Journal of Substance Abuse Treatment 2007: 32: 415-421.

26. Godinet M. T., McGlinn L., Nelson D., Vakalahi H. O. Factors Contributing to Substance Misuse Treatment Completion among Native Hawaiians, Other Pacific Islanders, and Asian Americans, Substance use & misuse 2020: 55: 133-146.

27. Hawkins E. J. P. D., Baer J. S. P. D., Kivlahan D. R. P. D. Concurrent monitoring of psychological distress and satisfaction measures as predictors of addiction treatment retention, Journal of Substance Abuse Treatment 2008: 35: 207-216.

28. López-Goñi J. J., Fernández- Montalvo J., Illescas C., Landa N., Lorea I. a. Determining socio-demographic predictors of treatment dropout: results in a therapeutic community, International Journal of Social Welfare 2008: 17: 374-378.

29. Mennis J. P. D., Stahler G. J. P. D. Racial and Ethnic Disparities in Outpatient Substance Use Disorder Treatment Episode Completion for Different Substances, Journal of Substance Abuse Treatment 2016: 63: 25-33.

30. Stones B., Dennis C. B. Childhood Trauma and Substance Use Treatment Length of Stay and Completion, Alcoholism Treatment Quarterly 2023: 1-13.

31. Turan R., Yargic I. The Relationship Between Substance Abuse Treatment Completion, Sociodemographics, Substance Use Characteristics, and Criminal History, Substance Abuse 2012: 33: 92-98.

32. Gisev N., Bharat C., Larney S., Dobbins T., Weatherburn D., Hickman M. et al. The effect of entry and retention in opioid agonist treatment on contact with the criminal justice system among opioid-dependent people: a retrospective cohort study, The Lancet Public health 2019: 4: e334-e342.

33. Oliver P., Keen J., Rowse G., Ewins E., Griffiths L., Mathers N. The effect of time spent in treatment and dropout status on rates of convictions, cautions and imprisonment over 5 years in a primary care-led methadone maintenance service, Addiction 2010: 105: 732-739.

34. Klingemann H. Successes and failures in treatment of substance abuse: Treatment system perspectives and lessons from the European continent\*, Nordic Studies on Alcohol and Drugs 2020: 37: 323-337.

35. Mateo Pinones M., González-Santa Cruz A., Portilla Huidobro R., Castillo-Carniglia A. Evidence-based policymaking: Lessons from the Chilean Substance Use Treatment Policy, International Journal of Drug Policy 2022: 109.

36. Marín-Navarrete R., Medina-Mora M. a. E., Pérez-López A., Horigian V. E. Development and evaluation of addiction treatment programs in Latin America, Current Opinion in Psychiatry 2018: 31: 306-314.

37. Olivari C. F., Gonzáles-Santa Cruz A., Mauro P. M., Martins S. S., Sapag J., Gaete J. et al. Treatment outcome and readmission risk among women in women-only versus mixed-gender drug treatment programs in Chile, Journal of Substance Abuse Treatment 2022: 134.

38. Babor T. Treatment Systems for Population Management of Substance Use Disorders: Requirements and Priorities from a Public Health Perspective. In: el-Guebaly N., Carrà G., Galanter M. & Baldacchino A. M., editors. Textbook of addiction treatment : international perspectives

Cham, Switzerland: Springer; 2021.

39. Krebs C. P., Strom K. J., Koetse W. H., Lattimore P. K. The Impact of Residential and Nonresidential Drug Treatment on Recidivism among Drug-Involved Probationers: A Survival Analysis, Crime & Delinquency 2009: 55: 442-471.

40. Hernán MA R. J. Causal Inference: What If. : Chapman & Hall/CRC. ; 2020.

41. Royston P. Flexible Parametric Alternatives to the Cox Model: Update, The Stata Journal 2004: 4: 98-101.

42. Royston P., & Lambert, P. C. Flexible parametric survival analysis using Stata: beyond the Cox model  College Station, TX: Stata press; 2011.

43. Stekhoven D. J., & Bühlmann, P. MissForest--non-parametric missing value imputation for mixed-type data. , Bioinformatics (Oxford, England) 2012: 28: 112-118.

44. Schemper M., Wakounig S., Heinze G. The estimation of average hazard ratios by weighted Cox regression, Statistics in Medicine 2009: 28: 2473-2489.

45. Decker K. P., Peglow S. L., Samples C. R., Cunningham T. D. Long-Term Outcomes After Residential Substance Use Treatment: Relapse, Morbidity, and Mortality, Military medicine 2017: 182: e1589-e1595.

46. McKay J. R., Weiss R. V. A Review of Temporal Effects and Outcome Predictors in Substance Abuse Treatment Studies With Long-Term Follow-Ups: Preliminary Results and Methodological Issues, Evaluation Review 2001: 25: 113-161.

47. Zarkin G. A., Cowell A. J., Hicks K. A., Mills M. J., Belenko S., Dunlap L. J. et al. Lifetime Benefits and Costs of Diverting Substance-Abusing Offenders From State Prison, Crime & Delinquency 2015: 61: 829-850.

48. Hubbard R. L., Craddock S. G., Anderson J. Overview of 5-year followup outcomes in the drug abuse treatment outcome studies (DATOS), Journal of substance abuse treatment 2003: 25: 125-134.

49. Turnbull P. The relationship between drugs and crime and its implications for recovery and desistance. In: Best D. C. C., editor. Strengths-Based Approaches to Crime and Substance Use : From Drugs and Crime to Desistance and Recovery, Milton: Routledge; 2019.

50. Farhoudian A., Razaghi E., Hooshyari Z., Noroozi A., Pilevari A., Mokri A. et al. Barriers and Facilitators to Substance Use Disorder Treatment: An Overview of Systematic Reviews, Substance Abuse: Research and Treatment 2022: 16.

**Tables**

Table 1. Characteristics of the study sample

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Covariate | | Overall (n=70854) | Treatment completion (n=19276) | Late dropout (n=35781) | Early dropout (n=15797) | Statistic | P value |
| Outcome 1. CJS contact | Yes | 22281 (31.4) | 3825  (19.8) | 12326 (34.4) | 6130 (38.8) | X²(2, 70854)=1750 | <0,001 |
| Outcome 2. CJS contact leading to imprisonment | Yes | 5141  (7.3) | 664  (3.4) | 2766  (7.7) | 1711 (10.8) | X²(2, 70854)=728; | <0,001 |
| Sex (%) | Men | 54042 (76.3) | 14232 (73.8) | 27568 (77.0) | 12242 (77.5) | X²(2, 70854)=88; | <0,001 |
| Women | 16812 (23.7) | 5044 (26.2) | 8213 (23.0) | 3555 (22.5) |  |  |
| Corrected birth year (median [IQR]) |  | 1980.00 [1971.00, 1987.00] | 1976.00 [1967.00, 1984.00] | 1980.00 [1972.00, 1987.00] | 1982.00 [1975.00, 1988.00] | H(2)=2147.6, p=0 | <0,001 |
| Age (admission to treatment) (median [IQR]) |  | 34.06 [27.39, 42.91] | 37.55 [29.58, 47.19] | 33.49 [27.12, 41.90] | 31.91 [25.95, 39.67] | H(2)=2037.6, p=0 | <0,001 |
| Poverty of the Municipality of residence (median [IQR]) |  | 0.12 [0.07, 0.17] | 0.11 [0.07, 0.17] | 0.12 [0.08, 0.17] | 0.11 [0.07, 0.15] | H(2)=346.6, p=0 | <0,001 |
| Urbanicity of the commune of residence (%) | Urbana | 58268 (82.2) | 15287 (79.3) | 29383 (82.1) | 13598 (86.1) | X²(4, 70852)=298; | <0,001 |
| Mixed | 6834  (9.6) | 2069  (10.7) | 3477  (9.7) | 1288  (8.2) |  |  |
| Rural | 5750  (8.1) | 1920  (10.0) | 2921  (8.2) | 909  (5.8) |  |  |
| [Missing] | 2 (0.0) | 0 (0.0) | 0 (0.0) | 2 (0.0) |  |  |
| Occupational Status (f) (%) | Employed | 35364 (49.9) | 9788  (50.8) | 18698 (52.3) | 6878 (43.5) | X²(10, 70853)=698; | <0,001 |
| Inactive | 7168 (10.1) | 2363  (12.3) | 3449  (9.6) | 1356  (8.6) |  |  |
| Looking for a job for the first time | 159  (0.2) | 49  (0.3) | 73  (0.2) | 37  (0.2) |  |  |
| No activity | 3558 (5.0) | 986  (5.1) | 1512  (4.2) | 1060  (6.7) |  |  |
| Not seeking for work | 712  (1.0) | 214  (1.1) | 295  (0.8) | 203  (1.3) |  |  |
| Unemployed | 23892 (33.7) | 5876  (30.5) | 11753 (32.8) | 6263 (39.6) |  |  |
| [Missing] | 1  (0.0) | 0  (0.0) | 1  (0.0) | 0  (0.0) |  |  |
| Education (%) | 3-Completed primary school or less | 20245 (28.6) | 4996  (25.9) | 10448 (29.2) | 4801 (30.4) | X²(4, 70538)=438; | <0,001 |
| 2-Completed high school or less | 39034 (55.1) | 10272 (53.3) | 19910 (55.6) | 8852 (56.0) |  |  |
| 1-More than high school | 11259 (15.9) | 3926  (20.4) | 5260 (14.7) | 2073 (13.1) |  |  |
| [Missing] | 316  (0.4) | 82  (0.4) | 163  (0.5) | 71  (0.4) |  |  |
| Tenure status of household (%) | Illegal Settlement | 749  (1.1) | 193  (1.0) | 344  (1.0) | 212  (1.3) | X²(8, 66796)=313; | <0,001 |
| Others | 2003  (2.8) | 518  (2.7) | 1057  (3.0) | 428  (2.7) |  |  |
| Owner/Pays Dividends | 24812 (35.0) | 7724  (40.1) | 12133 (33.9) | 4955 (31.4) |  |  |
| Renting | 12091 (17.1) | 3283  (17.0) | 6105 (17.1) | 2703 (17.1) |  |  |
| Stays temporarily with a relative | 27141 (38.3) | 6674  (34.6) | 14258 (39.8) | 6209 (39.3) |  |  |
| [Missing] | 4058  (5.7) | 884  (4.6) | 1884  (5.3) | 1290  (8.2) |  |  |
| Having children (%) | No | 16427 (23.2) | 4448  (23.1) | 8172 (22.8) | 3807 (24.1) | X²(2, 70250)= 9; | 0,009 |
| Yes | 53823 (76.0) | 14668 (76.1) | 27282 (76.2) | 11873 (75.2) |  |  |
| [Missing] | 604  (0.9) | 160  (0.8) | 327  (0.9) | 117  (0.7) |  |  |
| Cohabitation status (Recoded) (f) (%) | Alone | 6686  (9.4) | 2015  (10.5) | 3035  (8.5) | 1636 (10.4) | X²(6, 70853)=216; | <0,001 |
| Family of origin | 29336 (41.4) | 7453  (38.7) | 15040 (42.0) | 6843 (43.3) |  |  |
| Others | 6109  (8.6) | 1611  (8.4) | 2996  (8.4) | 1502  (9.5) |  |  |
| With couple/children | 28722 (40.5) | 8197  (42.5) | 14709 (41.1) | 5816 (36.8) |  |  |
| [Missing] | 1  (0.0) | 0  (0.0) | 1  (0.0) | 0  (0.0) |  |  |
| Treatment Modality (%) | Outpatient | 60398 (85.2) | 15605 (81.0) | 32129 (89.8) | 12661 (80.1) | X²(2, 70786)=1200; | <0,001 |
| In patient | 10397 (14.7) | 3656  (19.0) | 3620 (10.1) | 3115 (19.7) |  |  |
| [Missing] | 68  (0.1) | 15  (0.1) | 32  (0.1) | 21  (0.1) |  |  |
| Geographical area (%) | Center | 53678 (75.8) | 13616 (70.6) | 28245 (78.9) | 11817 (74.8) | X²(4, 70839)=1034; | <0,001 |
| North | 10486 (14.8) | 2933  (15.2) | 4598 (12.9) | 2955 (18.7) |  |  |
| South | 6675  (9.4) | 2724  (14.1) | 2937  (8.2) | 1014  (6.4) |  |  |
| [Missing] | 15  (0.0) | 3  (0.0) | 1  (0.0) | 11  (0.1) |  |  |
| Substance use onset age (median [IQR]) |  | 15.00 [14.00, 18.00] | 16.00 [14.00, 18.00] | 15.00 [14.00, 18.00] | 15.00 [13.00, 17.00] | H(2)=471.9, p=0 | <0,001 |
| Primary Substance (admission to treatment) (%) | Alcohol | 23860 (33.7) | 8520  (44.2) | 11373 (31.8) | 3967 (25.1) | X²(8, 70853)=2149; | <0,001 |
| Cocaine hydrochloride | 13241 (18.7) | 3279  (17.0) | 7071 (19.8) | 2891 (18.3) |  |  |
| Cocaine paste | 27788 (39.2) | 5635  (29.2) | 14343 (40.1) | 7810 (49.4) |  |  |
| Marijuana | 4747  (6.7) | 1326  (6.9) | 2484  (6.9) | 937  (5.9) |  |  |
| Other | 1217  (1.7) | 516  (2.7) | 509  (1.4) | 192  (1.2) |  |  |
| [Missing] | 1  (0.0) | 0  (0.0) | 1  (0.0) | 0  (0.0) |  |  |
| Primary Substance (initial diagnosis) (%) | Alcohol | 38408 (54.2) | 11793 (61.2) | 18989 (53.1) | 7626 (48.3) | X²(8, 65068)=932; | <0,001 |
| Cocaine hydrochloride | 2605  (3.7) | 566  (2.9) | 1390  (3.9) | 649  (4.1) |  |  |
| Cocaine paste | 3311  (4.7) | 631  (3.3) | 1639  (4.6) | 1041  (6.6) |  |  |
| Marijuana | 19138 (27.0) | 4123  (21.4) | 9883 (27.6) | 5132 (32.5) |  |  |
| Other | 1606  (2.3) | 480  (2.5) | 748  (2.1) | 378  (2.4) |  |  |
| [Missing] | 5786  (8.2) | 1683  (8.7) | 3132  (8.8) | 971  (6.1) |  |  |
| SUD Severity (Dependence status) (%) | Substance use dependence | 51160 (72.2) | 13401 (69.5) | 25654 (71.7) | 12105 (76.6) | X²(2, 70853)=228; | <0,001 |
| Hazardous consumption | 19693 (27.8) | 5875  (30.5) | 10126 (28.3) | 3692 (23.4) |  |  |
| [Missing] | 1  (0.0) | 0  (0.0) | 1  (0.0) | 0  (0.0) |  |  |
| Frequency of Substance Use (Primary Substance) (%) | Less than 1 day a week | 3495 (4.9) | 1062 (5.5) | 1855 (5.2) | 578  (3.7) | X²(8, 70499)=467; | <0,001 |
| 2 to 3 days a week | 20060 (28.3) | 5502  (28.5) | 10652 (29.8) | 3906 (24.7) |  |  |
| 4 to 6 days a week | 11611 (16.4) | 3035  (15.7) | 5956 (16.6) | 2620 (16.6) |  |  |
| 1 day a week or more | 4780  (6.7) | 1488  (7.7) | 2497  (7.0) | 795  (5.0) |  |  |
| Daily | 30553 (43.1) | 8101  (42.0) | 14640 (40.9) | 7812 (49.5) |  |  |
| [Missing] | 355  (0.5) | 88  (0.5) | 181  (0.5) | 86  (0.5) |  |  |
| Polysubstance use (%) | 0 | 18443 (26.0) | 6403  (33.2) | 8653 (24.2) | 3387 (21.4) | X²(2, 70854)=753; | <0,001 |
| 1 | 52411 (74.0) | 12873 (66.8) | 27128 (75.8) | 12410 (78.6) |  |  |
| Psychiatric Comorbidity (ICD-10) (%) | Without psychiatric comorbidity | 27921 (39.4) | 9251  (48.0) | 15725 (43.9) | 2945 (18.6) | X²(4, 70854)=23423; | <0,001 |
| Diagnosis unknown (under study) | 13273 (18.7) | 353  (1.8) | 3415  (9.5) | 9505 (60.2) |  |  |
| With psychiatric comorbidity | 29660 (41.9) | 9672  (50.2) | 16641 (46.5) | 3347 (21.2) |  |  |
| Severe physical comorbidity (%) | Without physical comorbidity | 28048 (39.6) | 7939  (41.2) | 14104 (39.4) | 6005 (38.0) | X²(4, 70854)=248; | <0,001 |
| Diagnosis unknown (under study) | 38392 (54.2) | 9804  (50.9) | 19535 (54.6) | 9053 (57.3) |  |  |
| One or more | 4414  (6.2) | 1533  (8.0) | 2142  (6.0) | 739  (4.7) |  |  |
| Violent Criminal Offences (Pre-Treatment) (%) | No | 58938 (83.2) | 16582 (86.0) | 29652 (82.9) | 12704 (80.4) | X²(2, 70854)=200; | <0,001 |
| Yes | 11916 (16.8) | 2694  (14.0) | 6129 (17.1) | 3093 (19.6) |  |  |
| Acquisitive Criminal Offences (Pre-Treatment) (%) | No | 58081 (82.0) | 16984 (88.1) | 29129 (81.4) | 11968 (75.8) | X²(2, 70854)=911; | <0,001 |
| Yes | 12773 (18.0) | 2292  (11.9) | 6652 (18.6) | 3829 (24.2) |  |  |
| Substance-Related Criminal Offences (Pre-Treatment) (%) | No | 58421 (82.5) | 16373 (84.9) | 29582 (82.7) | 12466 (78.9) | X²(2, 70854)=220; | <0,001 |
| Yes | 12433 (17.5) | 2903  (15.1) | 6199 (17.3) | 3331 (21.1) |  |  |
| Other Criminal Offences (Pre-Treatment) (%) | No | 58594 (82.7) | 16678 (86.5) | 29526 (82.5) | 12390 (78.4) | X²(2, 70854)=399; | <0,001 |
| Yes | 12260 (17.3) | 2598  (13.5) | 6255 (17.5) | 3407 (21.6) |  |  |

Notes. For categorical variables, frequencies (n) and percentages (%) in parenthesis; For continuous variables, median (Q2) and percentiles 25 (Q1) and 75 (Q3) in brackets. H= Kruskal-Wallis test for continuous variables; X2=Chi-square test for independence for categorical variables.

Table 2: Time until any contact with CJS (Outcome 1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Time** | **Complete Tr.** | **Late Dropout** | **Early Dropout** | **Comp. vs Late** | **Comp. vs Early** | **Early vs Late** |
| *Probs.* |  |  |  |  |  |  |
| 1\_yr | 90.1  (89.7, 90.5) | 84.6  (84.3, 85) | 83.0  (82.5, 83.5) | -5.5  (-6.0, -5.0) | -7.2  (-7.9, -6.5) | 1.7  (1.0, 2.3) |
| 3\_yrs | 79.4  (78.8, 80.0) | 70.8  (70.4, 71.3) | 68.9  (68.2, 69.6) | -8.6  (-9.3, -7.9) | -10.4  (-11.4, -9.5) | 1.9  (1.0, 2.7) |
| 5\_yrs | 73.5  (72.8, 74.2) | 64.0  (63.5, 64.5) | 62.3  (61.5, 63.1) | -9.5  (-10.3, -8.7) | -11.2  (-12.3, -10.1) | 1.7  (0.8, 2.7) |
| *RMST* |  |  |  |  |  |  |
| 1\_yr | 0.946  (0.943, 0.949) | 0.912  (0.910, 0.915) | 0.901  (0.897, 0.905) | -0.033 (-0.037, -0.030) | -0.045 (-0.049, -0.040) | 0.012  (0.007, 0.016) |
| 3\_yrs | 2.630  (2.617, 2.642) | 2.449  (2.440, 2.459) | 2.401  (2.385, 2.416) | -0.181 (-0.196, -0.165) | -0.229 (-0.250, -0.209) | 0.049  (0.030, 0.067) |
| 5\_yrs | 4.153  (4.129, 4.177) | 3.789  (3.771, 3.807) | 3.704  (3.675, 3.734) | -0.364 (-0.393, -0.334) | -0.448 (-0.489, -0.408) | 0.085  (0.049, 0.121) |

Note: All models adjusted for the covariates shown in Table 1 and used the imputation of missing values.

95% confidence intervals in parenthesis

Table 3: Time until contact with CJS leading to imprisonment (Outcome 2)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Time** | **Complete Tr.** | **Late Dropout** | **Early Dropout** | **Comp. vs Late** | **Comp. vs Early** | **Early vs Late** |
| *Probs*. |  |  |  |  |  |  |
| 1\_yr | 98.5  (98.3, 98.6) | 97.3  (97.1, 97.4) | 96.6  (96.4, 96.9) | -1.2  (-1.4, -1.0) | -1.8  (-2.1, -1.5) | 0.6  (0.3,0.9) |
| 3\_yrs | 96.4  (96.1, 96.7) | 94.3  (94.0, 94.5) | 93.2  (92.8, 93.5) | -2.2  (-2.5, -1.8) | -3.2  (-3.7, -2.8) | 1.1  (0.6,1.5) |
| 5\_yrs | 94.9  (94.6, 95.3) | 92.3  (92.0, 92.6) | 91.0  (90.5, 91.4) | -2.6  (-3.1, -2.2) | -4.0  (-4.6, -3.3) | 1.3  (0.8,1.9) |
| *RMST* |  |  |  |  |  |  |
| 1\_yr | 0.992  (0.991, 0.993) | 0.985  (0.984, 0.986) | 0.981  (0.979, 0.982) | -0.007 (-0.009, -0.006) | -0.011 (-0.013, -0.009) | 0.004 (0.002,0.006) |
| 3\_yrs | 2.939  (2.933, 2.945) | 2.897  (2.893, 2.902) | 2.876  (2.868, 2.883) | -0.042 (-0.049, -0.035) | -0.064 (-0.074, -0.054) | 0.022 (0.013,0.031) |
| 5\_yrs | 4.852  (4.840, 4.864) | 4.761  (4.751, 4.770) | 4.715  (4.700, 4.730) | -0.091 (-0.106, -0.076) | -0.137 (-0.157, -0.116) | 0.046 (0.027,0.065) |

Note: All models adjusted for the covariates shown in Table 1 and used the imputation of missing values.  
95% confidence intervals in parenthesis

Figure 1: Differences in survival probabilities and RMSTs for time-to any CJS contact (A, B) and contact leading to imprisonment (C, D).

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Note: Panels A) and C) depict differences in transition probabilities; Panels B) and D) depicts differences in RMSTs.