**PROGRESS REPORT**

**Impact of Poly-substance use on substance use disorder treatment completion between 2010-2019 in Chile**

**Research team**

Andrés González Santa Cruz

José Ruiz-Tagle Maturana

Mariel Mateo Piñones

Álvaro Castillo-Carniglia

March 2024

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# Project Overview

## Original project

* **Research question:** What are the mediating effects of completing SUD treatment on the relationship between baseline PSU and contact with CJS in Chile in the short (six months), middle (one year), and long term (three years)?
* **Aims:** Estimate the mediating effects of completing SUD treatment on the relationship between PSU at admission and contact with CJS among adult patients admitted to SUD treatment programs in Chile during 2010-2019. Specific: (1) To describe the prevalence of PSU, treatment completion, and contact with CJS in the sample, (2) to compare the risk of contact with CJS between people with poly and single-substance use, and (3) to estimate the proportion of the effect of PSU and treatment outcome on the contact with CJS.
* **Hypothesis:** Baseline PSU is related to lower treatment completion rates (1), baseline PSU is linked to a greater risk of contact with CJS (2), patients with PSU will have a differential risk of contact with CJS associated with treatment completion, and treatment completion will explain part of the relationship between PSU and contact with CJS (3).

## Modified project

* **Research question:** What are the effects of having reported polysubstance use (PSU) at admission to substance use disorder (SUD) treatments on treatment completion in Chile?
* **Specific Aims:** (1) To describe the incidence of PSU reports and treatment completion in the sample, (2) to compare the occurrence rate of treatment completion between people with reporting poly and single-substance use, and (3) to estimate the association between reporting PSU at admission and treatment completion, accounting for irregular and informative observation times.
* **Hypothesis:** Reporting PSU at admission to SUD treatment is related to lower treatment completion rates.

# Progress overview

In this section we described the main milestones achieved so far.

* **Data wrangling**

This research relies on a population-based record-linkage retrospective cohort design. The data wrangling includes managing an administrative database that contains information of patients receiving substance use treatment financed by the National Service for the Prevention and Rehabilitation of Drug and Alcohol Use (SENDA).

* *Data exploration and cleaning:* Considering all the variables available in the database, we explored the data focusing on missing data, variance, and other descriptive measures.
* *Data normalization:* We standardised variables, labelled fields, and corrected data integrity issues (e.g., typographical errors in dates, automation bias, or variations in name spelling or form). We also applied modification of time in months from the first admission for each subject and formatted to avoid overlapping between treatments.
* **Ethics application**

The study was approved by the Griffith University Human Research Ethics Committee (GUHREC GU Ref No: 2022/919).

* **Theoretical framework**

We have done a literature review according to the project design and the selected outcome variables. The theoretical framework progress is exposed in the next section (III). Changes to the theoretical framework will be introduced after concluding the analysis.

* **Preliminary analysis**
* *Data structure*

Patients’ entry to the retrospective cohort starts at the time they were admitted to a SUD treatment listed in the SENDAs yearly databases with information of treatments between 2010-2019. We considered patients that had ongoing treatments in 2010 until 2019. Censoring occurred after SENDA sent us the data (November 13, 2019), after an outcome event occurred, or when a patient left the cohort with no other outcomes. The exposure variable will be PSU at admission (using more than one main substance among alcohol and illicit drugs at admission to SUD treatment, whether sequential or concurrent) [(21,42)](https://www.zotero.org/google-docs/?RWcgt6), and the outcome variable will be SUD treatment outcome (1=dropout or spelled by misconduct). We excluded from the sample patients with only one treatment episode. The degree of irregularity of assessment times (times in which reported PSU was measured), in this case, admission, is measured in area under the curve and log-transformed area under the curve. To inspect the degree of visit irregularity, the entire follow-up period was divided into adjacent and equally sized timeframes, and the number of bins changed. The area under the curve obtained from plotting the mean proportions of individuals with 0 visits per bin against the mean proportions of individuals with > 1 visit per bin. AUC was log-transformed, in which 100 is very irregular, and 0 is equivalent to a repeated measures design.

* *Model adjustment*

Models such as marginal structural models, g-computation, and targeted maximum likelihood estimation assume that observation times and gaps between them are not informative of the outcome of interest. The study adjusts for various baseline and time-varying confounding variables related to substance use, demographics, and social factors. The study sample is based on a pseudo population in which the counting process (i.e., subsequent SUD treatment episodes and times between them) is static, hence, completely at random and ignorable [(43)](https://www.zotero.org/google-docs/?rNh4Qo), based on generalized estimating equations and inverse probability weights given previously observed data [(44)](https://www.zotero.org/google-docs/?jziS20). We obtained these stabilized weights from a proportional intensity model in which we adjusted for baseline covariates, previous treatment outcomes, and polysubstance use (if any). The weights are represented through a proportional intensity model as: , where is a vector of covariates before , is a vector of regression coefficients, and the denominator is , a constant baseline hazard to stabilize weights. Auxiliary covariates may include confounders of the outcome model. We estimated the relative risk of people with PSU completing at admission [(45)](https://www.zotero.org/google-docs/?taYqDf) using generalized estimating equations with a logit link function and assuming an independence structure.

* *Weighting process*

Covariates for weights are listed below: Treatment setting, Sex, Substance use onset age, Educational attainment, Primary substance at admission, Primary substance at admission usage frequency, Occupational status, Number of children (binary), Tenure status of households, Macrozone, Psychiatric comorbidity (ICD-10), Substance use severity (dependence status) (ICD-10) Urban/rural municipality of residence, Percentage of poverty of the municipality of residence, Initial substance, Birth year, Cohabitation status.

* *Data and code availability*

Preliminary code & markdowns are available here: <https://fondecytacc.github.io/nDP/index_prop_grant23_24.html>.

# Theoretical Framework

People with substance use disorder (SUD) tend to use more than one substance unintentionally and unnoticedly (e.g., due to unregulated and contaminated supplies) or intentionally [(1,2)](https://www.zotero.org/google-docs/?46rrTq) during active use in their lifetime [(3)](https://www.zotero.org/google-docs/?1KuRrw). Some reasons for intentional polysubstance use (PSU) include additive or synergistic reward, compensation for undesired effects or negative internal states, predisposition, or related to supply (e.g., due to shortages of the main substance). Importantly, people with PSU are a high-risk population because it is related to a higher mortality rate [(4)](https://www.zotero.org/google-docs/?Enneoe), a higher risk of relapse [(5,6)](https://www.zotero.org/google-docs/?2VWioo), less responsive to substance use treatment [(7)](https://www.zotero.org/google-docs/?aGS5WT), and other detrimental features such as risky sexual behavior [(8,9)](https://www.zotero.org/google-docs/?AyW0RR), violence [(10,11)](https://www.zotero.org/google-docs/?IYO3jK), and psychiatric comorbidities [(12)](https://www.zotero.org/google-docs/?M1Ejkj). Over the last three decades, evidence has shown that the rate of people with PSU has significantly increased, at least in high-income countries from North America, Europe, and Australia [(7)](https://www.zotero.org/google-docs/?14PxcU), highlighting the relevance of studying this topic.

Despite the association between completing SUD treatment and long-term benefits, such as lower risk of readmission to treatment [(13)](https://www.zotero.org/google-docs/?h4nNbK), lower risk of relapse [(14)](https://www.zotero.org/google-docs/?jCiQmB), abstinence [(15)](https://www.zotero.org/google-docs/?sg6HKy), and better quality of life [(16)](https://www.zotero.org/google-docs/?RnbDPE) is well known, evidence regarding the long-term consequences of reporting PSU on treatment outcomes is limited and mixed. The lack of research on PSU is partly because most studies have focused on individual substances in isolation and have considered a multiple substance use history as an exclusion criterion for clinical studies on treatment effectiveness, which raises the problem of its translatability to real health contexts [(7)](https://www.zotero.org/google-docs/?ZVxOYq). Regarding the treatment outcomes, some studies report a lower likelihood of treatment completion among people with PSU [(16–18)](https://www.zotero.org/google-docs/?fEUAWi), while others found no association [(19)](https://www.zotero.org/google-docs/?UZnxGp) or higher completion rates [(20)](https://www.zotero.org/google-docs/?Tef1bF). In any case, it is crucial to determine the role of reporting PSU in treatment completion to improve treatment effectiveness and research translatability [(21)](https://www.zotero.org/google-docs/?28SfsV).

However, this role must be understood in a context of patients who experience multiple and recursive treatments. Treatments are expected to change behavior relative to no treatment. Patients not benefiting from treatments often switch to other alternatives. Those facing adverse effects or resistance to change might quit, while some persevere and follow other recommendations, such as lifestyle changes that affect their prognosis. Hence, treatment outcomes such as dropout or treatment completion are linked to subsequent exposures such as a readmission to a posterior treatment, what is known as “feedback loop”. Given that SUD is understood as a chronic condition, the association between reporting PSU and treatment completion on first SUD treatment alone requires accounting that some patients may be readmitted to treatment through the follow-up period (See Figures 1a & 1b). Thus, checking for group biases and adjusting for confounders is needed [(23,24)](https://www.zotero.org/google-docs/?IkqGvO). Additionally, these treatments are irregularly spaced, nevertheless, not at random, as the time between treatments might be related to biopsychosocial and treatment-related factors. Thus, patients with worst outcomes in a previous treatment might have more or less intense frequency of treatments in the future, that may also explain treatment outcomes such as completion or dropout [(24,25)](https://www.zotero.org/google-docs/?5DuKZU).

Additionally, the relationship between people reporting PSU and treatment completion can be affected by various factors, such as heterogeneous PSU patterns [(7,26,27)](https://www.zotero.org/google-docs/?Onoy1v), treatment goals, patient characteristics, resource availability, and SUD severity profiles. In turn, these characteristics are highly dependent on treatment settings [(28–30)](https://www.zotero.org/google-docs/?vrtpYX). Most research on PSU comes from the Global North, where the treatment settings are usually specialized on particular substances [(31,32)](https://www.zotero.org/google-docs/?HKgQh5). This is not the reality of other contexts, such as Latin America, due to scarce resources and a shortage of mental health workforce, in which treatment is mostly delivered in non-specialized settings. However, studying the role of PSU on treatment outcomes in Latin America is challenging due to limited local data [(33)](https://www.zotero.org/google-docs/?Gwc0sa). Furthermore, using evidence from the Global North is not straightforward, as it focuses on opioids and injecting drug use, which are epidemiologic features that are not prevalent in the Latin American context [(34)](https://www.zotero.org/google-docs/?uujDwC).

Moreover, as many studies in the Global North have often overlooked high-risk populations, there are reasons to believe that is also the case in Latin America, where the prevalence of individuals with PSU is notably high [(35)](https://www.zotero.org/google-docs/?RoMGhL). A meta-analysis focusing on Global North studies on cocaine found that more than 70% of people who use cocaine have concurrent alcohol consumption. In addition, between 38% and 64% of the participants had concurrent marijuana use [(36)](https://www.zotero.org/google-docs/?yTvFsY). A recent study conducted in a Chilean hard-to-reach population that used cocaine base paste found that between 47% and 66% of users had simultaneous substance use [(37)](https://www.zotero.org/google-docs/?hdTPqS). Similarly, an analysis of data from studies conducted in six Latin American countries found that 21% of the participants reported PSU [(38)](https://www.zotero.org/google-docs/?IM9jJK), which was more frequent among males and young adults( 18-34) from Chile, Uruguay, and Argentina. In addition, PSU is related to school dropout, unemployment, sexual and antisocial risk behaviors [(37–39)](https://www.zotero.org/google-docs/?C8d9LT).

Chile has a robust public treatment system that produces a large and high-quality dataset that includes all treatment episodes of people with public health insurance (~80% of the population) since its creation in 2010 [(40)](https://www.zotero.org/google-docs/?Q8i6aF). Annually, nearly 15,000 individuals are admitted for treatment. Each patient identifies the primary substance that prompted them to seek treatment, as well as any additional substances that may have contributed to their decision. However, findings from the Chilean Budgetary Office study substantiate the need for further research to determine whether treatments address characteristics such as PSU behaviors effectively in a context where 2 out of 3 reported PSU [(41)](https://www.zotero.org/google-docs/?hZChgm). Understanding this relationship could inform effective prevention and intervention strategies for people with PSU. Moreover, expanding the knowledge about patterns of social inequalities and vulnerabilities in access to health services can serve as input to raise awareness among society and decision-makers and as a guide for developing policies and actions to reduce health inequities. Thus, this study aims to address this gap by estimating the effect of having reported PSU on treatment completion among adult patients admitted to SUD treatment programs in Chile from 2010-2019.

# Preliminary analysis

The preliminary analysis is structured with a summary of covariate baseline characteristics by polysubstance use status reported at admission. Then, we formatted the database and structured it by patient id and treatment number. Also, we provide a summary of the trajectories of patients by polysubstance use status and treatment outcome. Finally, we show a glimpse of missingness patterns.

* Characteristics of the study sample at treatment admission

Several key differences were notable among individuals reporting polysubstance use. Firstly, this group was younger at first treatment admission and began using substances at an earlier age. They were less likely to have completed primary education or less, and more commonly reported using cocaine paste and hydrochloride cocaine rather than alcohol as their primary substance. Furthermore, a higher percentage of these patients were unemployed, did not have children, and were more likely to be staying temporarily with a relative as opposed to homeownership. Geographically, there was a notable preference for living in the northern macrozone, with fewer residing in the south. Additionally, there were a higher incidence of diagnosed drug dependence among this population, and they were more likely to live in urban municipalities. When it comes to substance initiation, fewer started with alcohol, while more began with marijuana. These patients were typically born earlier and are more likely to live with their family of origin, rather than alone or with a partner and/or children. In terms of health, less had a mild but more had a severe biopsychosocial compromise. Lastly, less patients with PSU were in treatment in public centres, highlighting significant patterns and disparities within this group (See Table 1a). After discarding records of ongoing and treatments referred outside the treatment network, 72,404 patients with 90,075 treatments were selected (See Table 1b).

* Treatment history

In the total sample, 82% had one treatment and 1% had more than 3 treatments. As seen in Figure 2, patients had mostly one treatment, but, for example, subject no. 25 had 7 treatments in approximately 83 months, subject no. 21 had 3 treatments in the first 20 months, and subject no. 6 had a second treatment after approximately 80 months after the first follow-up period. What is particularly interesting is that in patients with only one treatment, 72% reported PSU, but if we take a look into patients with 2, 3 or four and more treatments, report PSU in 80%, 84% and 88% of their treatment episodes, respectively. Thus, exposure to PSU would be overrepresented in the sample if we do not account for the fact that being measured (due to readmission) informs PSU. This association also emerges if we inspect the number of treatments and the proportion of non-completed treatments. 71% of patients with only one treatment have not completed them, while 79%, 81% and 85% of the treatment episodes of patients with two, three or four and more correspond to noncompletion status, respectively. According to Figure 3, if we consider a bin width of 2% of the gap between treatments, the proportion of patients with >1 admissions was 0.06, until a bin width of 6% of the gap between treatments, reaching to a proportion of 0.01. An AUC of 0,07 (log-transformed= 20.2) suggest that although low, we can suspect a share of a counting process behind visits rather than a perfect repeated and thus regular measures. Thus, it seems reasonable to conduct an analysis that consider irregularity in observations and an extent of informative assessment times, conditional on a bulk of covariates, including past observed outcomes, past assessment history, and baseline covariates.

* Polysubstance use status, longitudinal patterns

As seen in Figure 4, patients change their polysubstance use reporting patterns over time. Trees of trajectories by treatment setting at baseline are available by treatment setting (<https://rpubs.com/ACCANID/tree>).

* Missing data

The proportion of missing data was 6.8% or less on an item level, leading with Age of onset of substance use (6.8%), first substance used (6.6%) housing situation (5.8%). However, 84% of the observations were complete.

* Modelling of the observation process

If we keep patients with more than one treatment, we get 13,317 patients and 30,988 observations from them. We tested several weighting schemes for the visiting process. We still have to incorporate time as a predictor (in its different parametric shapes), as well as baseline covariates, however, until now, we focused on two of the different tested specifications. Despite we are not planning to incorporate actual PSU because I tis the focus of the main analysis, we noticed that in many different specifications previous PSU had a protective effect if the rest of the lagged covariates was present. Additionally, this protective effect exacerbated if we fix the value of covariates to 0, even restricting the sample for patients with multiple treatments. On the contrary, the actual reported PSU had a risk effect if added (hazard ratio = 1.22, 95% confidence interval: 1.19–1.24). Even though, we found that predictors of previous treatment trajectories were associated with the outcome. As a result, if we want to measure the association between reported PSU and dropouts, we must incorporate the visit process (See Table 2).

# Next steps

* **Paper:** We have decided to submit our work to Drug and Alcohol Dependence (an International Journal), which is expected in April 2024.
* **Analytic steps:** We aim to select covariates adequately, grouping them according to the hypotheses and behavior. We are still reviewing antecedents and theoretical and empirical convenience of including one or another covariate (e.g., biopsychosocial compromise, treatment admission motive). We are exploring how PSU patterns change longitudinally, depending on previous treatment completion status and months spent in treatment (<3 vs. >= 3). These analyses will be stratified by baseline treatment setting due to expected unobserved differences among these groups. Another challenge that remains unexplored is the presence of missing values and imputation methods under Missing-at random. Given the complex longitudinal structure of the data, we will conduct random-forest-based imputation using the *missRanger* package. We will use 200 trees, using 3 candidate values of predictive matching (thus, aiming for plausible imputations given predictor values), with a maximum of 50 iterations per chaining steps. This imputation procedure may circumvent specification of interactions or nonparametric relationships and can handle collinearity between imputation variables. Lastly, we will conduct separate analyses by baseline treatment modality.
* **Presentation in Scientific meetings:** Our goal is to present this study at least at one international conference such as the National Institute on Drug Abuse International Forum, or in possible scientific community activities organized either by Griffith University (Australia), Universidad de Chile or other national institutions.

# References

Table 1a. Characteristics of the study sample

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Category** | **Overall (n= 85,048)** | **No PSU (n=22,552)** | **PSU (n=62,496)** | **Sig.** | **SMD** |
| Complete status of treatment (binary) (%) |  |  |  |  |  |  |
|  | Treatment completion | 19278 (22.7) | 6404 ( 28.4) | 12874 (20.6) | <0.001 | 0.183 |
|  | Treatment non-completion | 65761 (77.3) | 16148 ( 71.6) | 49613 (79.4) |  |  |
|  | [Missing] | 9 ( 0.0) | 0 ( 0.0) | 9 ( 0.0) |  |  |
| Age (admission to treatment) (median [Q1, Q3]) |  | 34.21 [27.41, 43.17] | 41.71 [32.29, 51.21] | 32.33 [26.45, 39.90] | <0.001 | 0.743 |
| Sex (%) | Women | 21020 (24.7) | 6050 ( 26.8) | 14970 (24.0) | <0.001 | 0.066 |
| Age of Onset of Substance Use (median [Q1, Q3]) |  | 15.00 [14.00, 18.00] | 17.00 [14.00, 20.00] | 15.00 [13.00, 17.00] | <0.001 | 0.425 |
| Educational Attainment (%) |  |  |  |  |  |  |
|  | 1-More than high school | 14068 (16.5) | 3215 ( 14.3) | 10853 (17.4) | <0.001 | 0.230 |
|  | 2-Completed high school or less | 46653 (54.9) | 11143 ( 49.4) | 35510 (56.8) |  |  |
|  | 3-Completed primary school or less | 23943 (28.2) | 8044 ( 35.7) | 15899 (25.4) |  |  |
|  | [Missing] | 384 ( 0.5) | 150 ( 0.7) | 234 ( 0.4) |  |  |
| Primary Substance (admission to treatment) (%) |  |  |  |  |  |  |
|  | Alcohol | 28859 (33.9) | 14212 ( 63.0) | 14647 (23.4) | <0.001 | 0.890 |
|  | Cocaine hydrochloride | 16151 (19.0) | 2337 ( 10.4) | 13814 (22.1) |  |  |
|  | Cocaine paste | 32681 (38.4) | 4511 ( 20.0) | 28170 (45.1) |  |  |
|  | Marijuana | 5771 ( 6.8) | 972 ( 4.3) | 4799 ( 7.7) |  |  |
|  | Other | 1585 ( 1.9) | 519 ( 2.3) | 1066 ( 1.7) |  |  |
|  | [Missing] | 1 ( 0.0) | 1 ( 0.0) | 0 ( 0.0) |  |  |
| Frequency of Substance Use (Primary Substance) (%) |  |  |  |  |  |  |
|  | 1. Less than 1 day a week | 4178 ( 4.9) | 1530 ( 6.8) | 2648 ( 4.2) | <0.001 | 0.186 |
|  | 2. 1 day a week or more | 5610 ( 6.6) | 1922 ( 8.5) | 3688 ( 5.9) |  |  |
|  | 3. 2 to 3 days a week | 23716 (27.9) | 6641 ( 29.4) | 17075 (27.3) |  |  |
|  | 4. 4 to 6 days a week | 13923 (16.4) | 3580 ( 15.9) | 10343 (16.5) |  |  |
|  | 5. Daily | 37200 (43.7) | 8744 ( 38.8) | 28456 (45.5) |  |  |
|  | [Missing] | 421 ( 0.5) | 135 ( 0.6) | 286 ( 0.5) |  |  |
| Corrected Occupational Status (%) |  |  |  |  |  |  |
|  | Employed | 41407 (48.7) | 12657 (56.1) | 28750 (46.0) | <0.001 | 0.276 |
|  | Inactive | 14258 (16.8) | 4206 (18.7) | 10052 (16.1) |  |  |
|  | Unemployed | 29382 (34.5) | 5688 (25.2) | 23694 (37.9) |  |  |
|  | [Missing] | 1 ( 0.0) | 1 ( 0.0) | 0 ( 0.0) |  |  |
| Number of Children (dichotomized) (%) |  |  |  |  |  |  |
|  | One or more | 64165 (75.4) | 18191 ( 80.7) | 45974 (73.6) | <0.001 | 0.172 |
|  | [Missing] | 745 ( 0.9) | 200 ( 0.9) | 545 ( 0.9) |  |  |
| Housing Situation (Tenure Status) (%) |  |  |  |  |  |  |
|  | Others | 3260 (3.8) | 809 (3.6) | 2451 (3.9) | <0.001 | 0.266 |
|  | Owner/Transferred dwellings/Pays Dividends | 29934 (35.2) | 9863 ( 43.7) | 20071 (32.1) |  |  |
|  | Renting | 14566 (17.1) | 3835 ( 17.0) | 10731 (17.2) |  |  |
|  | Stays temporarily with a relative | 32609 (38.3) | 6829 ( 30.3) | 25780 (41.3) |  |  |
|  | [Missing] | 4679 ( 5.5) | 1216 ( 5.4) | 3463 ( 5.5) |  |  |
| Macro Administrative Zone in Chile (%) |  |  |  |  |  |  |
|  | Center | 64341 (75.7) | 16681 ( 74.0) | 47660 (76.3) | <0.001 | 0.293 |
|  | North | 12151 (14.3) | 2243 ( 9.9) | 9908 (15.9) |  |  |
|  | South | 8536 (10.0) | 3625 ( 16.1) | 4911 ( 7.9) |  |  |
|  | [Missing] | 20 ( 0.0) | 3 ( 0.0) | 17 ( 0.0) |  |  |
|  |  |  |  |  |  |  |
| Psychiatric Comorbidity (ICD-10) (%) |  |  |  |  |  |  |
|  | Without psychiatric comorbidity | 32337 (38.0) | 10022 ( 44.4) | 22315 (35.7) | <0.001 | 0.184 |
|  | Diagnosis unknown (under study) | 16099 (18.9) | 3575 ( 15.9) | 12524 (20.0) |  |  |
|  | With psychiatric comorbidity | 36612 (43.0) | 8955 ( 39.7) | 27657 (44.3) |  |  |
| SUD Severity (Dependence status) (%) |  |  |  |  |  |  |
|  | Drug dependence | 61836 (72.7) | 13974 ( 62.0) | 47862 (76.6) | <0.001 | 0.321 |
|  | Hazardous consumption | 23211 (27.3) | 8577 ( 38.0) | 14634 (23.4) |  |  |
|  | [Missing] | 1 ( 0.0) | 1 ( 0.0) | 0 ( 0.0) |  |  |
| Urbanicity (%) |  |  |  |  |  |  |
|  | Mixed | 8205 ( 9.6) | 2850 ( 12.6) | 5355 ( 8.6) | <0.001 | 0.272 |
|  | Rural | 7148 ( 8.4) | 2977 ( 13.2) | 4171 ( 6.7) |  |  |
|  | Urban | 69693 (81.9) | 16724 ( 74.2) | 52969 (84.8) |  |  |
|  | [Missing] | 2 ( 0.0) | 1 ( 0.0) | 1 ( 0.0) |  |  |
| Percentage of people in poverty (median [Q1, Q3]) |  | 0.11 [0.07, 0.16] | 0.11 [0.07, 0.15] | 0.12 [0.08, 0.17] | <0.001 | 0.104 |
| Primary Substance (initial diagnosis) (%) |  |  |  |  |  |  |
|  | Alcohol | 46623 (54.8) | 15574 ( 69.1) | 31049 (49.7) | <0.001 | 0.505 |
|  | Cocaine hydrochloride | 3162 ( 3.7) | 957 ( 4.2) | 2205 ( 3.5) |  |  |
|  | Cocaine paste | 3864 ( 4.5) | 1321 ( 5.9) | 2543 ( 4.1) |  |  |
|  | Marijuana | 22991 (27.0) | 3083 ( 13.7) | 19908 (31.9) |  |  |
|  | Other | 1987 ( 2.3) | 563 ( 2.5) | 1424 ( 2.3) |  |  |
|  | [Missing] | 6421 ( 7.5) | 1054 ( 4.7) | 5367 ( 8.6) |  |  |
| Corrected birth year (median [IQR]) |  | 1980.00 [1971.00, 1987.00] | 1974.00 [1964.00, 1983.00] | 1982.00 [1974.00, 1988.00] | <0.001 | 0.630 |
| Cohabitation status (Recoded) (f) (%) |  |  |  |  |  |  |
|  | Alone | 8026 ( 9.4) | 2765 ( 12.3) | 5261 ( 8.4) | <0.001 | 0.342 |
|  | Family of origin | 35576 (41.8) | 6866 ( 30.4) | 28710 (45.9) |  |  |
|  | Others | 7291 ( 8.6) | 1802 ( 8.0) | 5489 ( 8.8) |  |  |
|  | With couple/children | 34154 (40.2) | 11118 ( 49.3) | 23036 (36.9) |  |  |
|  | [Missing] | 1 ( 0.0) | 1 ( 0.0) | 0 ( 0.0) |  |  |
| Physical Comorbidity (ICD-10) (%) |  |  |  |  |  |  |
|  | Without physical comorbidity | 33609 (39.5) | 8363 ( 37.1) | 25246 (40.4) | <0.001 | 0.084 |
|  | Diagnosis unknown (under study) | 45892 (54.0) | 12457 ( 55.2) | 33435 (53.5) |  |  |
|  | One or more | 5547 ( 6.5) | 1732 ( 7.7) | 3815 ( 6.1) |  |  |
| Biopsychosocial compromise (%) |  |  |  |  |  |  |
|  | 1-Mild | 7986 ( 9.4) | 3801 (16.9) | 4185 ( 6.7) | <0.001 | 0.420 |
|  | 2-Moderate | 48355 (56.9) | 13544 (60.1) | 34811 (55.7) |  |  |
|  | 3-Severe | 27150 (31.9) | 4743 (21.0) | 22407 (35.9) |  |  |
|  | [Missing] | 1557 ( 1.8) | 464 ( 2.1) | 1093 ( 1.7) |  |  |
| Treatment Admission Motive (%) |  |  |  |  |  |  |
|  | Spontaneous | 38028 (44.7) | 10097 (44.8) | 27931 (44.7) | <0.001 | 0.187 |
|  | Assisted Referral | 7967 ( 9.4) | 1455 ( 6.5) | 6512 (10.4) |  |  |
|  | Other | 4514 ( 5.3) | 1184 ( 5.3) | 3330 ( 5.3) |  |  |
|  | Justice Sector | 7976 ( 9.4) | 2787 (12.4) | 5189 ( 8.3) |  |  |
|  | Health Sector | 26563 (31.2) | 7029 (31.2) | 19534 (31.3) | <0.001 |  |
| Public treatment center | TRUE | 60958 (71.7) | 19135 (84.8) | 41823 (66.9) | <0.001 | 0.429 |
|  | [Missing] | 20 ( 0.0) | 3 ( 0.0) | 17 ( 0.0) |  |  |

Note. n= frequency of patients; descriptive statistics of baseline characteristics used the median (Q2) and percentiles 25 and 75 in brackets for continuous variables. Furthermore, categorical variables are represented in frequencies and percentages (%) in parenthesis.

Table 1b. Characteristics of the study sample (excluding ongoing treatment episodes or external referrals)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Category** | **Overall (n= 72,404)** | **No PSU (n=18,707)** | **PSU (n=53,697)** | **Sig.** | **SMD** |
| Complete status of treatment (binary) (%) | Treatment completion | 19278 (26.6) | 6404 (34.2) | 12874 (24.0) | <0.001 | 0.228 |
|  | Treatment non-completion | 53117 (73.4) | 12303 (65.8) | 40814 (76.0) |  |  |
|  | [Missing] | 9 (0.0) | 0 (0.0) | 9 (0.0) |  |  |
| Age (admission to treatment) (median [Q1, Q3]) |  | 34.04 [27.38, 42.84] | 41.40 [32.14, 50.94] | 32.27 [26.47, 39.76] | <0.001 | 0.736 |
| Sex (%) | Women | 17342 (24.0) | 4793 (25.6) | 12549 (23.4) | <0.001 | 0.052 |
| Age of Onset of Substance Use (median [IQ Q1, Q3R]) |  | 15.00 [14.00, 18.00] | 17.00 [14.00, 20.00] | 15.00 [13.00, 17.00] | <0.001 | 0.419 |
| Educational Attainment (%) |  |  |  |  |  |  |
|  | 1-More than high school | 11489 (15.9) | 2495 (13.3) | 8994 (16.7) | <0.001 | 0.236 |
|  | 2-Completed high school or less | 39904 (55.1) | 9289 (49.7) | 30615 (57.0) |  |  |
|  | 3-Completed primary school or less | 20685 (28.6) | 6797 (36.3) | 13888 (25.9) |  |  |
|  | [Missing] | 326 (0.5) | 126 (0.7) | 200 (0.4) |  |  |
| Primary Substance (admission to treatment) (%) |  |  |  |  |  |  |
|  | Alcohol | 24244 (33.5) | 11695 (62.5) | 12549 (23.4) | <0.001 | 0.877 |
|  | Cocaine hydrochloride | 13505 (18.7) | 1906 (10.2) | 11599 (21.6) |  |  |
|  | Cocaine paste | 28563 (39.4) | 3922 (21.0) | 24641 (45.9) |  |  |
|  | Marijuana | 4835 (6.7) | 784 (4.2) | 4051 (7.5) |  |  |
|  | Other | 1256 (1.7) | 399 (2.1) | 857 (1.6) |  |  |
|  | [Missing] | 1 (0.0) | 1 (0.0) | 0 (0.0) |  |  |
| Frequency of Substance Use (Primary Substance) (%) |  |  |  |  |  |  |
|  | 1. Less than 1 day a week | 3554 (4.9) | 1276 (6.8) | 2278 (4.2) | <0.001 | 0.189 |
|  | 2. 1 day a week or more | 4852 (6.7) | 1621 (8.7) | 3231 (6.0) |  |  |
|  | 3. 2 to 3 days a week | 20417 (28.2) | 5578 (29.8) | 14839 (27.6) |  |  |
|  | 4. 4 to 6 days a week | 11855 (16.4) | 2969 (15.9) | 8886 (16.5) |  |  |
|  | 5. Daily | 31363 (43.3) | 7145 (38.2) | 24218 (45.1) |  |  |
|  | [Missing] | 363 (0.5) | 118 (0.6) | 245 (0.5) |  |  |
| Corrected Occupational Status (%) |  |  |  |  |  |  |
|  | Employed | 35924 (49.6) | 10709 (57.2) | 25215 (47.0) | <0.001 | 0.275 |
|  | Inactive | 11760 (16.2) | 3350 (17.9) | 8410 (15.7) |  |  |
|  | Unemployed | 24719 (34.1) | 4647 (24.8) | 20072 (37.4) |  |  |
|  | [Missing] | 1 (0.0) | 1 (0.0) | 0 (0.0) |  |  |
| Number of Children (dichotomized) (%) | One or more | 54984 (75.9) | 15188 (81.2) | 39796 (74.1) | <0.001 | 0.174 |
|  | [Missing] | 618 (0.9) | 163 (0.9) | 455 (0.8) |  |  |
| Housing Situation (Tenure Status) (%) |  |  |  |  |  |  |
|  | Others | 2804 (3.9) | 689 (3.7) | 2115 (3.9) | <0.001 | 0.268 |
|  | Owner/Transferred dwellings/Pays Dividends | 25339 (35.0) | 8171 (43.7) | 17168 (32.0) |  |  |
|  | Renting | 12354 (17.1) | 3145 (16.8) | 9209 (17.1) |  |  |
|  | Stays temporarily with a relative | 27759 (38.3) | 5637 (30.1) | 22122 (41.2) |  |  |
|  | [Missing] | 4148 (5.7) | 1065 (5.7) | 3083 (5.7) |  |  |
| Macro Administrative Zone in Chile (%) |  |  |  |  |  |  |
|  | Center | 54864 (75.8) | 13988 (74.8) | 40876 (76.1) | <0.001 | 0.292 |
|  | North | 10690 (14.8) | 1882 (10.1) | 8808 (16.4) |  |  |
|  | South | 6833 (9.4) | 2835 (15.2) | 3998 (7.4) |  |  |
|  | [Missing] | 17 (0.0) | 2 (0.0) | 15 (0.0) |  |  |
| Psychiatric Comorbidity (ICD-10) (%) |  |  |  |  |  |  |
|  | Without psychiatric comorbidity | 28308 (39.1) | 8542 (45.7) | 19766 (36.8) | <0.001 | 0.187 |
|  | Diagnosis unknown (under study) | 13616 (18.8) | 2918 (15.6) | 10698 (19.9) |  |  |
|  | With psychiatric comorbidity | 30480 (42.1) | 7247 (38.7) | 23233 (43.3) |  |  |
| SUD Severity (Dependence status) (%) | Drug dependence | 52416 (72.4) | 11498 (61.5) | 40918 (76.2) | <0.001 | 0.322 |
|  | [Missing] | 1 (0.0) | 1 (0.0) | 0 (0.0) |  |  |
| Urbanicity (%) |  |  |  |  |  |  |
|  | Mixed | 6938 (9.6) | 2359 (12.6) | 4579 (8.5) | <0.001 | 0.267 |
|  | Rural | 5861 (8.1) | 2382 (12.7) | 3479 (6.5) |  |  |
|  | Urban | 59603 (82.3) | 13965 (74.7) | 45638 (85.0) |  |  |
|  | [Missing] | 2 (0.0) | 1 (0.0) | 1 (0.0) |  |  |
| Percentage of people in poverty (median [Q1, Q3]) |  | 0.12 [0.07, 0.17] | 0.11 [0.07, 0.16] | 0.12 [0.08, 0.17] | <0.001 | 0.105 |
| Primary Substance (initial diagnosis) (%) |  |  |  |  |  |  |
|  | Alcohol | 39227 (54.2) | 12844 (68.7) | 26383 (49.1) | <0.001 | 0.506 |
|  | Cocaine hydrochloride | 2681 (3.7) | 769 (4.1) | 1912 (3.6) |  |  |
|  | Cocaine paste | 3401 (4.7) | 1149 (6.1) | 2252 (4.2) |  |  |
|  | Marijuana | 19644 (27.1) | 2589 (13.8) | 17055 (31.8) |  |  |
|  | Other | 1648 (2.3) | 457 (2.4) | 1191 (2.2) |  |  |
|  | [Missing] | 5803 (8.0) | 899 (4.8) | 4904 (9.1) |  |  |
| Corrected birth year (median [Q1, Q3]) |  | 1980.00 [1971.00, 1987.00] | 1973.00 [1964.00, 1983.00] | 1981.00 [1974.00, 1988.00] | <0.001 | 0.623 |
| Cohabitation status (Recoded) (f) (%) |  |  |  |  |  |  |
|  | Alone | 6816 (9.4) | 2276 (12.2) | 4540 (8.5) | <0.001 | 0.337 |
|  | Family of origin | 30074 (41.5) | 5648 (30.2) | 24426 (45.5) |  |  |
|  | Others | 6224 (8.6) | 1520 (8.1) | 4704 (8.8) |  |  |
|  | With couple/children | 29289 (40.5) | 9262 (49.5) | 20027 (37.3) |  |  |
|  | [Missing] | 1 (0.0) | 1 (0.0) | 0 (0.0) |  |  |
| Physical Comorbidity (ICD-10) (%) |  |  |  |  |  |  |
|  | Without physical comorbidity | 28661 (39.6) | 6946 (37.1) | 21715 (40.4) | <0.001 | 0.085 |
|  | Diagnosis unknown (under study) | 39215 (54.2) | 10372 (55.4) | 28843 (53.7) |  |  |
|  | One or more | 4528 (6.3) | 1389 (7.4) | 3139 (5.8) |  |  |
| Biopsychosocial compromise (%) |  |  |  |  |  |  |
|  | 1-Mild | 6954 (9.6) | 3231 (17.3) | 3723 (6.9) | <0.001 | 0.418 |
|  | 2-Moderate | 41015 (56.6) | 11147 (59.6) | 29868 (55.6) |  |  |
|  | 3-Severe | 22998 (31.8) | 3909 (20.9) | 19089 (35.5) |  |  |
|  | [Missing] | 1437 (2.0) | 420 (2.2) | 1017 (1.9) |  |  |
| Treatment Admission Motive (%) |  |  |  |  |  |  |
|  | Spontaneous | 32847 (45.4) | 8462 (45.2) | 24385 (45.4) | <0.001 | 0.191 |
|  | Assisted Referral | 6753 (9.3) | 1222 (6.5) | 5531 (10.3) |  |  |
|  | Other | 3935 (5.4) | 984 (5.3) | 2951 (5.5) |  |  |
|  | Justice Sector | 6813 (9.4) | 2380 (12.7) | 4433 (8.3) |  |  |
|  | Health Sector | 22056 (30.5) | 5659 (30.3) | 16397 (30.5) |  |  |
| Public treatment center | TRUE | 51710 (71.4) | 15899 (85.0) | 35811 (66.7) | <0.001 | 0.438 |
|  | [Missing] | 17 (0.0) | 2 (0.0) | 15 (0.0) |  |  |

Figure 1a. Causal diagram for reference

Diagrama

Descripción generada automáticamente

Note: A= Reporting PSU at admission; Y= Time to treatment completion status from admission; L0=Baseline confounders; {L1,L2, ... , Lt}= time-dependent biopsychosocial; U= Unobserved confounders; t= individual treatments from 2010)

Figure 1b. Causal diagram for hypothesized for the process of observation

Diagrama

Descripción generada automáticamente

Note. All the backdoors of the month of assessment (admission to treatment), may pass through observed outcomes, history of evolution or baseline covariates to impact on outcomes. If we assume that is a proportional intensity model holds, we can search evidence in the data that previous variables are associated with outcomes.

Source: Pullenayegum, E. M., & Scharfstein, D. O. (2022). Randomized Trials With Repeatedly Measured Outcomes: Handling Irregular and Potentially Informative Assessment Times. Epidemiologic Reviews, 44(1), 121-137. https://doi.org/10.1093/epirev/mxac010

Figure 2. Abacus plot of a random subsample of 25 patients along follow-up period

Gráfico

Descripción generada automáticamente

Note. Dot= treatment outcome; horizontal line= patients; seed at number 21251.

Figure 3. Mean proportions of patients with 0,1, and >1 admissions per bin as bin width varies from 1 to 50% of the gap between readmissions.

Diagrama

Descripción generada automáticamente

Note. Modified= Time in months from the first admission, and formatted to avoid overlapping between treatments, complete cases; Modified (imputation)= Time in months from the first admission, and formatted to avoid overlapping between treatments, imputed missing values; Original calendar= Formatted in calendar date, no further format.

Figure 4. Sankey plot of PSU reported at admission in the total sample at the first three treatments

Gráfico

Descripción generada automáticamente

Note. Patients= 72.404

Table 2. Specifications of the treatment (visit) process

|  |  |  |  |
| --- | --- | --- | --- |
| **Model** | **Term** | **Hazard ratio (95% CI)** | **Sig.** |
| First model | Previous dropout | 1.5 (1.43, 1.57) | <0.001 |
|  | Biopsychosocial compromise (moderate) | 1.06 (0.99, 1.13) | 0.090 |
|  | Biopsychosocial compromise (severe) | 1.57 (1.46, 1.67) | <0.001 |
|  | Less than 90 days in previous treatment | 1.71 (1.66, 1.78) | <0.001 |
|  | Reported PSU in previous treatment | 1.08 (1.04, 1.13) | <0.001 |
|  | Count of treatments | 0.97 (0.95, 1.00) | 0.030 |
| Second model |  |  |  |
|  | Previous dropout | 1.48 (1.42, 1.55) | <0.001 |
|  | Biopsychosocial compromise (moderate) | 1.05 (0.98, 1.12) | 0.180 |
|  | Biopsychosocial compromise (severe) | 1.61 (1.5, 1.71) | <0.001 |
|  | Less than 90 days in previous treatment | 1.77 (1.71, 1.82) | <0.001 |
|  | Reported PSU in previous treatment | 1.05 (1.00, 1.1) | 0.030 |
|  | Reported PSU in actual treatment | 1.22 (1.19, 1.24) | <0.001 |

Note. First model= In Andersen-Gill format, restricted to cases with more than one treatment and lag values were fixed to one (excepting on moderate biopsychosocial compromise); In Andersen-Gill format, not restricted to cases with more than one treatment and lag values were fixed to one (excepting on moderate biopsychosocial compromise).