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Persistent cannabis use among young adults with early psychosis receiving coordinated specialty care in the United States

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Abstract

Persistent cannabis use among young adults with first episode psychosis (FEP), even those receiving early intervention services, has been associated with poor outcomes. In the United States (US), Coordinated Specialty Care (CSC) has been shown to be more effective at reducing symptoms, improving quality of life and increasing involvement in work or school, compared to typical care for FEP. However, little is known about the prevalence, course and outcomes for cannabis use in this real-world, clinical setting. This study examined the prevalence, course and outcomes of cannabis use categorized into three groups: no use, reduced use, and persistent use, among a sample of 938 CSC participants enrolled for at least 1 year. Prevalence of cannabis use was 38.8% at admission and 32.8% of the sample had persistent cannabis use at 1 year. At baseline, persistent cannabis users were more likely to be male ($p < .001$), white, non-Hispanic and black non-Hispanic ($p = .001$), have worse symptoms as measured by the GAF ($p < .001$), increased suicidality ($p = .024$), violent ideation ($p = .008$), and legal trouble ($p = .006$) compared with non-users. At 1 year, persistent users maintained worse symptoms compared with non-users ($p = .021$) while those who reduced use had significant improvement in symptoms compared with persistent users ($p = .008$). This study suggests that cannabis use is common among young adults enrolled in a CSC program in the US and that persistent cannabis users may have worse outcomes while reducing cannabis use may improve outcomes. These findings highlight the potential impact of secondary prevention in this population through reduction in cannabis use.

Keywords

First episode psychosis; Early psychosis; Cannabis use; Substance use; Coordinated specialty care

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Declaration of competing interests

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Data availability

The data is available upon reasonable request from the corresponding author.

1. Introduction

Cannabis use has been implicated in both the development and progression of psychotic disorders (Leeson et al., 2012; Moore et al., 2007; Myles et al., 2016), based on evidence that demonstrates an increased risk of developing a psychotic disorder related to age at first use, frequency of use and potency of cannabis used (Compton et al., 2009; Di Forti et al., 2013; Large et al., 2011; Marconi et al., 2016). Despite this risk, cannabis is consistently reported as the most frequent and commonly used illicit substance among young people with early psychosis (Baeza et al., 2009; Lange et al., 2014; Van Mastrigt et al., 2004; Harrison et al., 2008). Within some first episode psychosis (FEP) samples, the prevalence of cannabis use is as high as 60–70% (Carr et al., 2009; Schimmelmann et al., 2012; Wade et al., 2005). Persistent cannabis use following onset of psychosis has been associated with poor outcomes including lower antipsychotic medication adherence, more symptoms, increased hospitalizations, and heightened risk of relapse (Mazzoncini et al., 2010; Patel et al., 2016; Schoeler et al., 2017; Seddon et al., 2016). Early intervention services for individuals with FEP, which is considered standard of care in this population (Malla and McGorry, 2019), have produced decreased cannabis use in a subgroup of individuals, however, many individuals with FEP maintain persistent use despite treatment (Addington and Addington, 2007; Carr et al., 2009; Schimmelmann et al., 2012).

Most of the research focusing on cannabis use in FEP has examined European, Canadian or Australian cohorts receiving some type of early intervention services (Schoeler et al., 2016a, 2016b; Zammit et al., 2008). In the United States, Coordinated Specialty Care (CSC) has been shown to be more effective at reducing symptoms, improving quality of life and increasing involvement in work or school, compared to treatment as usual (Kane et al., 2015) and is being implemented across the country (https://www.nimh.nih.gov/health/topics/schizophrenia/raise/what-is-coordinated-specialty-care-csc.shtml, accessed 12/2/2019). Little is known about the prevalence, course and outcomes for cannabis use in this setting. Of the few studies conducted in the U.S., The Recovery After an Initial Schizophrenia Episode-Early Treatment Program study (RAISE-ETP) tested a CSC model (NAVIGATE) for early psychosis (Kane et al., 2015) and used a combination of motivational, educational, and cognitive-behavioral strategies (Cather et al., 2018) for those participants who used substances as part of the treatment model. At baseline, almost half of the participants (48.8%) reported drug or alcohol use, and over half (51.7%) met the criteria for a lifetime SUD, with cannabis use disorder accounting for 34.7% (Cather et al., 2018). The RAISE-ETP study observed no reduction in cannabis use among patients during the two-year period, with substance use rates remaining stable over time (Cather et al., 2018). In a separate analysis, baseline cannabis use was found to be associated with higher scores on the PANSS positive subscale and on the Clinical Global Impressions (CGI) scale during treatment, but cannabis use over time was not examined (Oluwoye et al., 2019).

To address this gap in the literature, this paper aims to better understand the course of cannabis use and the impact of persistent use on symptoms and functioning in a cohort of young adults with FEP enrolled in a CSC program in the United States called OnTrackNY.

This paper had several aims:

1. To describe the prevalence and course of cannabis use over a one-year follow up period among a sample of young adults with early psychosis;
2. To examine differences in baseline characteristics between courses of cannabis use over one-year follow up (persistent and reduced use) compared with non-users; and
3. To examine associations between courses of cannabis use and concurrent clinical outcomes.

2. Methods and materials

2.1. Participants and study design

OnTrackNY, a CSC program, consists of a recovery-oriented, multidisciplinary team delivering evidence-based psychosocial interventions and medication to young people with the recent onset of a non-affective psychotic disorder (Bello et al., 2017; Dixon et al., 2015). Teams work with participants and families on individual goals related to school, work and relationships. OnTrackNY sites are located in licensed outpatient clinics at community agencies, state-operated facilities, and community and academic hospitals in urban and suburban areas throughout New York State (NYS). Eligibility criteria for OnTrackNY enrollment includes individuals ages 16–30 years who experienced non-affective psychosis for less than two years. The research sample was limited to those who were enrolled at one of 19 OnTrackNY sites from October 2013 through December 2017 and had at least one year of possible follow up (N = 938).

OnTrackNY clinicians submit client-level data to the NYS Office of Mental Health (OMH) at admission to OnTrackNY, quarterly, and at discharge for quality improvement and fidelity monitoring. Data are collected using standardized admission forms which clinicians complete through report of participants and their families, and chart review. For research purposes, all data are deidentified and protected health information was removed from the dataset by OMH prior to data sharing with research teams. The New York State Psychiatric Institute (NYSPI) Institutional Review Board reviewed the study procedures and did not consider this secondary data analysis human subjects research, therefore it was exempt from approval.

2.2. Measures

Domains assessed included demographics, family/social characteristics, and clinical characteristics. All measures are considered “current” or “recent” when assessed at baseline or in the 90 days prior to the assessment, unless otherwise stated. This cutoff was determined from a programmatic perspective by OnTrackNY program staff and OMH. Demographics included age, gender, race/ethnicity, health insurance status, current employment or education status. Current employment or education was defined as those who were enrolled in an education program (full or part-time, including high school, vocational training, college, or graduate study) or had any paid employment (including competitive or non-competitive work, self-employment, or internship) at the time of admission to

OnTrackNY. Family and social characteristics included homelessness, family contact, and legal issues. Homelessness was defined as any client who spent ANY time sleeping in a homeless shelter, on the street, public place (e.g., subway), place not meant for sleeping, or temporary place that is not the client's residence (e.g., "couch surfing") in the 90-days prior to admission. Family involvement included who the client lived with and frequency of contact with family at time of admission. Legal issues were defined as having any legal issues, including being on parole or probation in the 90 days prior to admission. This measure was only analyzed for a subset of participants for whom the data was available.

Baseline clinical characteristics included MIRECC Global Assessment of Functioning (GAF) (Niv et al., 2007) symptom, occupational and social functioning scales at the time of admission; suicidal or violent ideation or behavior; tobacco, alcohol or other drug use at admission; age at onset of psychosis; time from onset to enrollment in OnTrackNY. Scores on the MIRECC GAF range from 0 to 100, with scores below 40 considered in the impaired range and scores of 70 and above considered normal range. Suicidal and violent ideation or behavior included any report of suicidal ideation or attempts or of violent or aggressive ideation or behavior in the 90 days prior to admission. Tobacco, alcohol or other drug use at admission was defined as "any" use in the 90 days prior to admission for each of the substances based on clinician report. Team clinicians assessed the time of onset of qualifying psychotic symptoms based on participant and/or family member report as well as collateral information from medical records or other sources as part of the initial evaluation of each participant. Age at onset of psychosis was calculated based upon the date of onset of qualifying psychotic symptoms and date of birth of the participant.

Current cannabis use was defined as "any" use in the 90 days prior to admission and each quarterly assessment, based on clinician report. In addition to GAF scores and education/employment (defined above), other longitudinal clinical outcomes included hospitalizations, medication adherence, and early discharge. Hospitalizations were defined as any psychiatric hospitalizations, excluding substance use rehabilitation or detoxification admissions, in the 90 days prior to assessment. Medication prescription and adherence was defined as having been prescribed an antipsychotic medication, and for those being prescribed, whether they had adherence of at least 80% in the month prior (Haynes, 1976) to each assessment based on clinician report. Early discharge was defined as any individual who left the program within 12 months of being enrolled for any reason.

2.3. Statistical analyses

The first aim was to describe the prevalence and course of cannabis use at admission and through follow-up periods. The course of cannabis use was categorized into three groups: no use, reduced use, and persistent use. The 'no-use' category included participants whose clinicians reported they never used cannabis at admission or through their follow-up periods. The 'reduced use' category included participants whose clinicians reported they used cannabis at admission, but then discontinued use at some time during the follow-up period. The 'persistent use' category included those who used continuously from admission through follow-up, those who used on and off through follow-up, and those who were not using at admission but began using during follow-up.

For the second aim, descriptive summaries of baseline characteristics were calculated stratified by course of cannabis use with means and standard deviations for normally distributed continuous measures, medians and interquartile ranges for skewed measures, and proportions for categorical measures. Associations between each baseline measure and the three groups (i.e. no use, reduced use, and persistent use) were tested using one-way ANOVAs, non-parametric Kruskal-Wallis test, or chi-square tests depending on the distribution of the characteristic. Pairwise comparisons between groups were computed when the overall test was significant at $p < .05$.

The third aim included examining the association between course of cannabis use and clinical outcomes. Longitudinal mixed effects models were run using an identity link function for continuous clinical outcomes (GAF scores) and a logit link function for dichotomous clinical outcomes (education/employment, psychiatric hospitalizations, medication adherence). Each model included an autoregressive covariance structure for the errors over time to account for within-subject correlation. The continuous outcome models additionally included a random effect for site, but for dichotomous outcome models, including site did not allow the models to converge and it was not included. Each model included as predictors the course of cannabis use (no use, reduced use, and persistent use), follow-up time (baseline, 3, 6, 9, and 12 months), and their interaction. Pre-specified contrasts were computed to assess the pairwise and overall effect of course of cannabis use at baseline, at 12-month follow-up, and of the change from baseline to 12-month follow-up. Each model additionally controlled for age, gender, race, and an indicator of whether the person had an early discharge (discharge prior to 1-year of admission). Finally, a Cox proportional hazard model was fit to assess the effect of course of cannabis use on early discharge controlling for the same covariates of age, gender, and race. This model included a 2-way interaction between course of cannabis use by time to estimate the pairwise effects specifically at 12-month follow-up.

All analyses were done using SAS version 9.4, and all hypothesis tests were two-sided with 5% significance level. Due to the exploratory nature of these analyses, pre-specified clinically meaningful contrasts below 10% significance level are presented as well. Missing data was limited in this dataset due to data collection and quality procedures, with a range of 0.5% to 6% missing for the MIRECC GAF, employment/education, and psychiatric outcomes, and a range between 3.4% to 9.3% for medication adherence. Data was assumed to be missing at random in statistical analyses.

3. Results

3.1. Sample characteristics

Demographics, social and clinical characteristics of the sample are presented in Table 1. This sample included all participants that were enrolled prior to 2018, and therefore had at least one-year of possible follow-up. At admission, the participants were on average 21 years old, were mostly male (74%), with 27% white non-Hispanic, 36% black non-Hispanic, 28% Hispanic, and 10% other races (Asians, American Indian/Alaskan Native, and Native Hawaiian/Other Pacific Islander). About 40% were either employed or in school, only 5% were uninsured, 46% had public insurance and 41% had private insurance. The majority

lived with parents (84%) and had daily family contact (91%), while 6% reported being homeless.

3.2. Course of cannabis use (aim 1)

At admission, 38.8% of participants reported cannabis use within the prior 90 days. (Data not shown) The prevalence decreased from baseline to 3 months and then remained steady across time at approximately 25% at months 3, 6, 9, and 12. About half (50.64%, n = 475) of the participants reported no use at admission and throughout all follow-up visits (i.e., no use group) and 16.52% (n = 155) reported use at admission, and then no longer used by end of follow-up (i.e. reduced use group). The remaining participants (32.84%, 308) had either mixed use or continued use from enrollment and through follow-up (i.e., persistent group).

3.3. Characteristics associated with course of cannabis use (aim 2)

The association of baseline characteristics with course of cannabis use is shown in Table 1.

Gender and race/ethnicity was significantly associated with course of cannabis use (both $p < .001$) with the no use group having significantly greater proportion of females compared to the reduced group (31.6% vs 19.4% female) and to the persistent group (31.6% vs 18.2% female), and having a greater proportion of Hispanics and other races compared to the reduced and persistent groups. GAF occupational (OC) and GAF symptom scores at admission also were significantly associated with courses of cannabis use ($p = .027$ and $p < .001$, respectively) with the persistent group having significantly lower scores (ie., worse) in both the OC (Mean (SD) = 34.1 (18.3) vs 37.9 (21.4)) and symptoms (Mean (SD) = 28.3 (13.7) vs 32.5 (15.9)) domains compared to the no use group. Violent ideation/behavior, suicidal ideation/behavior, and legal issues were also significantly related to course of cannabis use ($p = .017$, $p = .045$, $p = .021$, respectively) with the persistent use group having significantly higher proportions of participants with baseline violent ideation/behavior (27.3% vs 19.2%), suicidal ideation/behavior (32.5% vs 25.1%), and legal issues (16.9% vs 7.9%) compared to the no use group. Baseline tobacco, alcohol, and other drug use were significantly related to course of cannabis use (all $p < .001$). The cannabis no use group had significantly lower baseline use of tobacco, alcohol, and other drugs (6.3%, 12.6%, and 1.1%, respectively) compared to the reduced use (18.1%, 45.8%, and 14.2, respectively) and persistent use (25.3%, 33.8%, and 8.8%, respectively) groups. Additionally, baseline alcohol use was significantly higher in the reduced use group than the persistent use group (45.8% vs 14.2%). Medication prescription and adherence at admission was significantly related to course of cannabis use, with the no use group more likely to be medication adherent when prescribed anti-psychotic medication compared to the reduced group (72.8% vs 61.9%). No differences were found on other variables.

3.4. Course of cannabis use and concurrent clinical outcomes (aim 3)

Observed mean GAF scores along with 1-standard error bars during one-year follow-up by course of cannabis use are shown in Fig. 1, and results of linear models are presented in Table 2. The course of cannabis use was significantly associated with GAF symptoms at 12-month follow-up ($p = .013$). At 12-months, those with persistent cannabis use had significantly lower GAF symptoms compared to those with reduced cannabis use ($b = -3.39$,

p = .021), but this effect was not different than the effect seen at baseline (baseline: b = −3.06, p = .012; change from BL to 12 months: b = −0.32, p = .858). At 12 months compared to baseline, those with reduced use tended to have a greater improvement in symptoms compared to both persistent users and nonusers (change from baseline to 12 months: b = 4.20, p = .093; b = 3.87, p = .100, respectively), with the reduced users achieving significantly higher symptom scores (i.e., better) at 12-months than those with persistent use (b = 5.33, p = .008). When adjusting for covariates, course of cannabis use was not significantly associated with GAF social functioning (SF) or GAF OC scores at 12-month follow-up (p = .683 and p = .612, respectively).

The observed prevalence of categorical clinical outcomes along with 1-standard error bars are presented in Fig. 2, and results of logistic regression models are presented in Table 3. Course of cannabis use was not significantly associated with education/ employment at 12-month follow-up (p = .735), but course of cannabis use was related to psychiatric hospitalization at 12-month follow-up where persistent users had higher odds of hospitalizations compared to those with no use (log-odds = 0.72, p = .020). Additionally, from baseline to 12-months, those with reduced use tended to have a reduction in hospitalizations compared to persistent users (log-odds = −0.93, p = .060). Course of cannabis use was significantly associated with medication adherence at 12 months. Reduced users had lower odds of medication adherence compared to non-users (log-odds = −0.67, p = .006), but this was not different than the effect at baseline (baseline: log-odds = −0.60, p = .008; change from baseline to 12 months: b = −0.07, p = .823).

The cumulative incidence of early-discharge by course of cannabis use is presented in Fig. 3, and results of Cox-proportional hazard model on time to early discharge are presented in Table 3. At 12-month follow-up, course of cannabis use was not significantly related to time to early discharge (p = .128), however, those with reduced cannabis use tended to be more likely to discharge earlier than persistent users and non-users at 12-month follow-up (HR = 1.92, p = .052 and HR = 1.68, p = .090, respectively).

4. Discussion

To our knowledge, this is the first study to examine prevalence, baseline characteristics and outcomes associated with cannabis use over time in a US-based FEP cohort enrolled in a coordinated specialty care program. We found a moderately high prevalence rate of recent cannabis use (38.8% in the prior 90 days) at baseline which is higher than prevalence rates found in the RAISE-ETP trial (23.6% past month use of cannabis) and lower than that of the EPICENTER trial (48% in the prior 6 months), but the time course over which cannabis use was measured varied (Cather et al., 2018; Breitborde et al., 2015). One year after enrollment, 16.5% of those who were using cannabis at admission stopped while roughly one-third had persistent use. While we cannot draw conclusions given the lack of a control group, these data suggest that the substance use treatment component of OnTrackNY, which utilizes at stage-wise motivational approach may help a subset of cannabis users reduce their use, but persistent use remains high and problematic and may require a more effective intervention. In the RAISE-ETP trial, self-reported cannabis use did not differ over 2 years in the NAVIGATE treatment condition compared with community care and the rate of heavy

cannabis use was twice as high in the treatment arm compared with community care, even after controlling for baseline heavy cannabis use (Cather et al., 2018; Alcover et al., 2019). These studies and our findings support the need for further research into development, adaptation and implementation of effective interventions to reduce cannabis use among young adults with early psychosis. Several trials have examined interventions employing motivational interviewing and/or cognitive behavioral therapy treatments to reduce cannabis use in this population, with poor results (Bonsack et al., 2011; Edwards et al., 2006; Madigan et al., 2013).

Demographic characteristics found to be associated with cannabis use include gender and race/ethnicity. A significantly higher proportion of reduced and persistent users were males compared with non-users, consistent with other FEP cohorts (Donoghue et al., 2014; Arranz et al., 2015; Setien-Suero et al., 2017; Seddon et al., 2016). The sex differences in cannabis use among FEP are not well understood. Studies suggest that an interaction between gender and substance use in FEP may impact the age of onset of psychosis and possibly outcomes (Donoghue et al., 2014; Arranz et al., 2015; Lange et al., 2014). Further research is needed to examine sex differences among cannabis and substance users more generally in FEP to better clarify the etiology of the differences and potential impact on treatment outcomes. A higher proportion of non-users were also Hispanic or other race/ethnicity compared with reduced or persistent use groups. These findings mirror those of the general population which demonstrate lower overall rates of cannabis use among Hispanics and Asians, who make up the majority of the “other” race/ethnicity category within OnTrackNY (Hasin et al., 2019). It is important to note that prevalence rates among these minority groups are on the rise, and as the prevalence of marijuana use increases in the general population (Hasin et al., 2015) we may see the differences in prevalence by gender and race/ethnicity in FEP populations begin to decrease also.

At baseline, both the persistent cannabis use group and reduced use group were found to have worse symptoms and lower functioning compared with non-users, consistent with findings from the RAISE-ETP study (Oluwoye et al., 2019) though the differences for the reduced use group did not reach statistical significance, likely due to a smaller sample size. We also found that cannabis users (persistent and reduced) had higher rates of recent suicidal ideation, violent ideation, and legal issues at baseline, compared with non-users, which may be driven by an overall increase in positive psychotic or more depressive symptoms as demonstrated by lower GAF symptom scores. Increased risk of suicide attempts has been associated with co-morbid substance use at baseline in FEP (Togay et al., 2015) and violence and legal issues have also been found to be associated with cannabis use in cross-sectional studies (Rolin et al., 2019). Overall, this sample had similar baseline prevalence of alcohol and other drug use compared with RAISE ETP (Cather et al., 2018), but substantially lower prevalence compared with the EPICENTER study (Breitborde et al., 2015). It is possible these differences are due to different screening/eligibility criteria, with OnTrackNY and RAISE-ETP screening out individuals with more significant substance use, compared with EPICENTER. The finding of higher baseline alcohol use among reduced cannabis users is interesting, and to our knowledge, has not been previously reported. Further research examining the interaction between alcohol and cannabis use, particularly among those who reduce or stop use is warranted. Contrary to other findings (Leeson et al., 2012), cannabis

use in this sample was not associated with better social functioning. Given the cross-sectional nature of the data at baseline and lack of data regarding onset of use and premorbid functioning, we cannot determine the direction of the relationship between these clinical characteristics and cannabis use. What the data does demonstrate from a clinical perspective is that at entry into CSC, individuals who are using cannabis are more symptomatic and it is difficult to differentiate those individuals who will ultimately reduce or stop using and those who will persist and potentially require more effective substance use interventions.

There were no differences between the three groups at one year in GAF occupational functioning scores or achievement of work or school. OnTrackNY participants achieve high rates of employment and education overall based on findings from previous studies (Nossel et al., 2018; Humensky et al., 2019). OnTrackNY uses a supported employment and education approach based on the Individual Placement and Support (IPS) model that supports individual client goals for work or education with zero exclusion and ongoing support from the team's full-time supported employment and education specialist. This model has been shown to improve rates of competitive employment for individuals with severe mental illness (Marino and Dixon, 2014) and this approach may contribute to the lack of difference in employment and education outcomes seen among cannabis users versus non-users in OnTrackNY.

Persistent cannabis use was associated with lower GAF symptom scores and increased likelihood of hospitalization compared with nonusers, while those who reduced or stopped use appear to have greater improvement than both groups and achieve outcomes similar to nonusers. In a meta-analysis conducted by Schoeler et al. (2016a), continued cannabis users showed similar levels of functioning compared to non-users, but those who discontinued use had higher levels of functioning than non-users. In a prospective study by Schoeler et al. (2016b), those with persistent cannabis use had greatest risk of relapse (defined as hospitalization), while those who were former users had the lowest risk. In addition, we found that those who reduced/stopped use had lower medication adherence compared with non-users over time, but there was no significant difference in medication adherence over time among persistent users compared with non-users, which decreased slightly at six months but then remained stable in both groups. In contrast, Schoeler et al., 2017 found that medication adherence is worse among persistent users and may mediate some of the risk of relapse. Faridi et al., 2012 also found that medication adherence mediated the impact of persistent cannabis use on symptoms, but over time persistent users had substantially greater medication adherence compared with those who stop using. The authors suggest that these inconsistent findings may be due to participation in an intensive early intervention program which provides counseling and education around the importance of medication adherence and also offers the opportunity for shared decision making with patients which allows patients the room to make decisions about taking medication, as well as their substance use (Faridi et al., 2012), similar to the CSC model. Further research is needed to examine the interaction between cannabis use, medication adherence and symptoms over time in this setting.

Finally, those who reduced their cannabis use also trended toward being more likely to have an early discharge compared with non-users and persistent users. Taken together, the

findings in this study suggest that reducing and/or stopping cannabis use may result in improved symptoms and decreased likelihood of hospitalization which could explain lower medication adherence and early drop-out. One hypothesis is that some of the symptomatology in the cannabis users may be related to the effects of cannabis itself and once they reduce or stop using cannabis, their symptoms improve, they stop taking medications and may be more likely to leave the program; however, more research is needed to investigate these associations.

The study is limited by the constraints of data collection in a clinical rather than research context. All assessments were developed for clinical use by OnTrackNY and assessments are conducted quarterly. With the exception of the MIRECC GAF, many of the measures used for data collection within OnTrackNY are not research measures. Quarterly data collection is performed and submitted to OMH by clinical staff and may be subject to site differences in how clinical assessment data is obtained. For example, our measure for cannabis use is based on the clinician report of “any cannabis use in the prior 90 days” and the clinic-level assessment of cannabis use that informs this measure may vary by clinic or by clinician. We recognize this variable is limited and may likely result in underreporting of cannabis use and an underestimate of the actual prevalence and scope of cannabis use in this sample. In addition, we do not know the pattern of cannabis use of those individuals with early drop-out which limits the interpretation of longitudinal findings. This dataset also does not include measures of lifetime cannabis use, age at onset of cannabis use, frequency or severity of use or other premorbid functioning measures, which may be factors relevant to the outcomes which are unable to be examined in this data. Finally, this is an observational study with no control group and caution should be used when interpreting findings.

The findings of this study suggest that cannabis use is common among young adults enrolled in a CSC program in the US and that individuals with persistent cannabis use may have worse outcomes while reducing cannabis use may improve outcomes. Given the high prevalence of cannabis use in this population and the changing landscape of legalization in the US, it is imperative to develop and test interventions to reduce cannabis use in the CSC setting.

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References

Addington J, Addington D, 2007. Patterns, predictors and impact of substance use in early psychosis: a longitudinal study. Acta Psychiatr. Scand. 115 (4), 304–309. 10.1111/j.1600-0447.2006.00900.x. [PubMed: 17355521]

Alcover K, Oluwoye O, Kriegel L, McPherson S, McDonell M, 2019. Impact of first episode psychosis treatment on heavy cannabis use: Secondary analysis of RAISE-ETP study. Schizophr. Res 211, 86–87. 10.1016/j.schres.2019.07.014. [PubMed: 31378555]

Arranz B, Safont G, Corripio I, Ramirez N, Duenas RM, Perez V, et al., 2015. Substance use in patients with first-episode psychosis: is gender relevant? J. Dual Diagn. 11 (3±4), 153–60. 10.1080/15504263.2015.1113761. [PubMed: 26513726]

Baeza I, Graell M, Moreno D, Castro-Fornieles J, Parellada M, González-Pinto A, ... Arango C, 2009. Cannabis use in children and adolescents with first episode psychosis: influence on psychopathology and short-term outcome (CAFEPS study). Schizophr. res 113 (2-3), 129–137. 10.1016/j.schres.2009.04.005. [PubMed: 19427172]

Bello I, Lee R, Malinovsky I, Watkins L, Nossel I, Smith T, Dixon LB, 2017. OnTrackNY: the development of a coordinated specialty care program for individuals experiencing early psychosis. Psychiatr. Serv 68, 318–320. 10.1176/appi.ps.201600512. [PubMed: 27973999]

Bonsack C, Manetti SG, Favrod J, Montagrin Y, Besson J, Bovet P, Conus P, 2011. Motivational intervention to reduce cannabis use in young people with psychosis: a randomized controlled trial. Psychother. Psychosom 80 (5), 287–297. 10.1159/000323466. [PubMed: 21646823]

Breitborde NJ, Bell EK, Dawley D, Woolverton C, Ceaser A, Waters AC, ... Harrison-Monroe P, 2015. The Early Psychosis Intervention Center (EPICENTER): development and six-month outcomes of an American first-episode psychosis clinical service. BMC Psychiatry 15, 266. 10.1186/s12888-015-0650-3. [PubMed: 26511605]

Carr JA, Norman RM, Manchanda R, 2009. Substance misuse over the first 18 months of specialized intervention for first episode psychosis. Early Interv. in Psychiatry 3 (3), 221–225. 10.1111/j.1751-7893.2009.00136.x.

Cather C, Brunette MF, Mueser KT, Babbin SF, Rosenheck R, Correll CU, Kalos-Meyer P, 2018. Impact of comprehensive treatment for first episode psychosis on substance use outcomes: a randomized controlled trial. Psychiatry Res. 268, 303–311. 10.1016/j.psychres.2018.06.055. [PubMed: 30086471]

Compton MT, Kelley ME, Ramsay CE, Pringle M, Goulding SM, Esterberg ML, ... Walker EF, 2009. Association of pre-onset cannabis, alcohol, and tobacco use with age at onset of prodrome and age at onset of psychosis in first-episode patients. American Journal of Psychiatry 166 (11), 1251–1257.

Di Forti M, Sallis H, Allegri F, Trotta A, Ferraro L, Stilo SA, ... Dazzan P, 2013. Daily use, especially of high-potency cannabis, drives the earlier onset of psychosis in cannabis users. Schizophrenia bull 40 (6), 1509–1517. 10.1093/schbul/sbt181.

Dixon LB, Goldman HH, Bennett ME, Wang Y, McNamara KA, Mendon SJ, Essock SM, 2015. Implementing coordinated specialty care for early psychosis: the RAISE connection program. Psychiatr. Serv. 66, 691–698. 10.1176/appi.ps.201400281. [PubMed: 25772764]

Donoghue K, Doody GA, Murray RM, Jones PB, Morgan C, Dazzan P, et al., 2014. Cannabis use, gender and age of onset of schizophrenia: data from the AESOP study. Psychiatry Res. 215 (3), 528–532. 10.1016/j.psychres.2013.12.038. [PubMed: 24461684]

Edwards J, Elkins K, Hinton M, Harrigan SM, Donovan K, Athanasopoulos O, McGorry PD, 2006. Randomized controlled trial of a cannabis-focused intervention for young people with first-episode psychosis. Acta Psychiatr. Scand. 114 (2), 109–117. 10.1111/j.1600-0447.2006.00783.x. [PubMed: 16836598]

Faridi K, Joober R, Malla A, 2012. Medication adherence mediates the impact of sustained cannabis use on symptom levels in first-episode psychosis. Schizophrenia Res 141, 78–82. 10.1016/j.schres.2012.07.023.

Harrison I, Joyce EM, Mutsatsa SH, Hutton SB, Huddy V, Kapasi M, Barnes TRE, 2008. Naturalistic follow-up of co-morbid substance use in schizophrenia: the West London first-episode study. Psychol. Med 38 (1), 79–88. 10.1017/S0033291707000797. [PubMed: 17532864]

Hasin DS, Saha TD, Kerridge BT, Goldstein RB, Chou SP, Zhang H, ... Huang B, 2015. Prevalence of marijuana use disorders in the United States between 2001–2002 and 2012–2013. JAMA psychiatry 72 (12), 1235–1242. 10.1001/jamapsychiatry.2015.1858. [PubMed: 26502112]

Hasin DS, Shmulewitz D, Sarvet AL, 2019. Time trends in US cannabis use and cannabis use disorders overall and by sociodemographic subgroups: a narrative review and new findings. The Am. J. of Drug and Alcohol Abus. 165, 181–190. 10.1080/00952990.2019.1569668.

Haynes RB, 1976. A critical review of the “determinants” of patient compliance with therapeutic regimens. In: Sackett DL, Haynes RB (Eds.), Compliance with Therapeutic Regimens. Johns Hopkins University Press, Baltimore, MD, pp. 26–39.

Humensky JL, Nossel I, Bello I, Dixon LB, 2019. Supported education and employment services for young people with early psychosis in OnTrackNY. J.L of Men. Health Policy and Econ.S 22 (3), 95–108.

Kane JM, Robinson DG, Schooler NR, Mueser KT, Penn DL, Rosenheck RA, ... Marcy P, 2015. Comprehensive versus usual community care for first-episode psychosis: 2-year outcomes from the NIMH RAISE early treatment program. Am. J. of Psychiatry 173 (4), 362–372. 10.1176/appi.ajp.2015.15050632. [PubMed: 26481174]

Lange EH, Nesvåg R, Ringen PA, Hartberg CB, Haukvik UK, Andreassen OA, ... Agartz I, 2014. One year follow-up of alcohol and illicit substance use in first-episode psychosis: does gender matter? Compr. psychiatry 55 (2), 274–282. 10.1016/j.comppsych.2013.08.018. [PubMed: 24262129]

Large M, Sharma S, Compton MT, Slade T, Nielssen O, 2011. Cannabis use and earlier onset of psychosis: a systematic meta-analysis. Arch. of gen.psychiatry 68 (6), 555–561. 10.1001/archgenpsychiatry.2011.5. [PubMed: 21300939]

Leeson VC, Harrison I, Ron MA, Barnes TR, Joyce EM, 2012. The effect of cannabis use and cognitive reserve on age at onset and psychosis outcomes in first-episode schizophrenia. Schizophrenia bull 38 (4), 873–880. 10.1093/schbul/sbq153.

Madigan K, Brennan D, Lawlor E, Turner N, Kinsella A, O'Connor JJ, ... O'Callaghan E, 2013. A multi-center, randomized controlled trial of a group psychological intervention for psychosis with comorbid cannabis dependence over the early course of illness. Schizophrenia res 143 (1), 138–142. 10.1016/j.schres.2012.10.018.

Malla A, McGorry P, 2019. Early intervention in psychosis in young people: a population and public health perspective. AJPH 109 (S3), S181–S184. 10.2105/AJPH.2019.305018.

Marconi A, Di Forti M, Lewis CM, Murray RM, Vassos E, 2016. Meta-analysis of the association between the level of cannabis use and risk of psychosis. Schizophrenia bull 42 (5), 1262–1269. 10.1093/schbul/sbw003.

Marino LA, Dixon LB, 2014. An update on supported employment for people with severe mental illness. Curr. opin. in psychiatry 27 (3), 210–215. 10.1097/YCO10.1097/YCO.0000000000000058.

Mazzoncini R, Donoghue K, Hart J, Morgan C, Doody GA, Dazzan P, ... Fearon P, 2010. Illicit substance use and its correlates in first episode psychosis. Acta Psychiatrica Scandinavica 121 (5), 351–358. 10.1111/j.1600-0447.2009.01483.x. [PubMed: 19824986]

Moore TH, Zammit S, Lingford-Hughes A, Barnes TR, Jones PB, Burke M, Lewis G, 2007. Cannabis use and risk of psychotic or affective mental health outcomes: a systematic review. Lancet 370 (9584), 319–328. 10.1016/S0140-6736(07)61162-3. [PubMed: 17662880]

Myles H, Myles N, Large M, 2016. Cannabis use in first episode psychosis: meta-analysis of prevalence, and the time course of initiation and continued use. Aust. & N.Z. J. of Psychiatry 50 (3), 208–219. 10.1177/0004867415599846.

Niv N, Cohen AN, Sullivan G, Young AS, 2007. The MIRECC version of the global assessment of functioning scale: reliability and validity. Psychiatr. Serv 58, 529–535. 10.1176/ps.2007.58.4.529. [PubMed: 17412856]

Nossel I, Wall MM, Scodes J, Marino L, Zilkha S, Bello I, ... Dixon LB, 2018. Outcomes and predictors in OnTrackNY, a coordinated specialty care program for early psychosis. Psychiatric Serv 69 (8), 863–870.

Oluwoye O, Monroe-DeVita M, Burduli E, Chwastiak L, McPherson S, McClellan JM, McDonell MG, 2019. Impact of tobacco, alcohol and cannabis use on treatment outcomes among patients experiencing first episode psychosis: data from the national RAISE-ETP study. Early Interv Psychiatry 13 (1), 142–146. 10.1111/eip.12542. [PubMed: 29356438]

Patel R, Wilson R, Jackson R, Ball M, Shetty H, Broadbent M, ... Bhattacharyya S, 2016. Association of cannabis use with hospital admission and antipsychotic treatment failure in first episode psychosis: an observational study. BMJ open 6 (3), e009888. 10.1136/bmjopen-2015-009888.

Rolin SA, Marino LA, Pope LG, Compton MG, Lee RJ, Rosenfeld B, Dixon LB, 2019. Recent violence and legal involvement among young adultswith early psychosis enrolled in coordinated specialty care. Early Interv Psychiatry 13, 832–840. 10.1111/eip.12675. [PubMed: 29740953]

Schimmelmann BG, Conus P, Cotton S, Kupferschmid S, McGorry PD, Lambert M, 2012. Prevalence and impact of cannabis use disorders in adolescents with early onset first episode psychosis. Eur. Psychiatry 27 (6), 463–469. 10.1016/j.eupsy.2011.03.001. [PubMed: 21616646]

Schoeler T, Monk A, Sami MB, Klamerus E, Foglia E, Brown R, ... Bhattacharyya S, 2016a. Continued versus discontinued cannabis use in patients with psychosis: a systematic review and meta-analysis. The Lancet Psychiatry 3 (3), 215–225. 10.1016/S2215-0366(15)00363-6. [PubMed: 26777297]

Schoeler T, Petros N, Di Forti M, Klamerus E, Foglia E, Anjnakina O, ... Bhattacharyya S, 2016b. Effects of continuation, frequency, and type of cannabis use on relapse in the first 2 years after onset of psychosis: an observational study. The Lancet Psychiatry 3, 947–953. 10.1016/S2215-0366(16)30188-2. [PubMed: 27567467]

Schoeler T, Petros N, Di Forti M, Klamerus E, Foglia E, Murray R, Bhattacharyya S, 2017. Poor medication adherence and risk of relapse associated with continued cannabis use in patients with first-episode psychosis: a prospective analysis. Lancet Psychiatry 4 (8), 627–633. [PubMed: 28705600]

Seddon JL, Birchwood M, Copello A, Everard L, Jones PB, Fowler D, ... Singh SP, 2016. Cannabis use is associated with increased psychotic symptoms and poorer psychosocial functioning in first-episode psychosis: a report from the UK national EDEN study. Schizophrenia bull 42 (3), 619–625. 10.1093/schbul/sbv154.

Setien-Suero E, Neergaard K, RamõÂrez-Bonilla M, Correa-Ghisays P, FañanaÂs L, Crespo-Facorro B, Ayesa-Arriola R, 2017. Cannabis use in male and female first episode of non-affective psychosis patients: long-term clinical, neuropsychological and functional differences. PLoS One 12 (8), e0183613. 10.1371/journal.pone.0183613. [PubMed: 28832666]

Togay B, Noyan H, Tasdelen R, Ucok A, 2015. Clinical variables associated with suicide attempts in schizophrenia before and after the first episode. Psychiatric Res 229 (1–2), 252–256. 10.1016/j.psychres.2015.07.025.

Van Mastrigt S, Addington J, Addington D, 2004. Substance misuse at presentation to an early psychosis program. Soc. psychiatry and psychiatr. epidemiol 39 (1), 69–72. 10.1007/s00127-004-0713-0. [PubMed: 15022049]

Wade D, Harrigan S, Edwards J, Burgess PM, Whelan G, McGorry PD, 2005. Patterns and predictors of substance use disorders and daily tobacco use in first-episode psychosis. Aust. and N.Z. J. of Psychiatry 39 (10), 892–898. [PubMed: 16168016]

Zammit S, Moore TH, Lingford-Hughes A, Barnes TR, Jones PB, Burke M, Lewis G, 2008. Effects of cannabis use on outcomes of psychotic disorders: systematic review. The Br. J. of Psychiatry 193 (5), 357–363. 10.1192/bjp.bp.107.046375. [PubMed: 18978312]

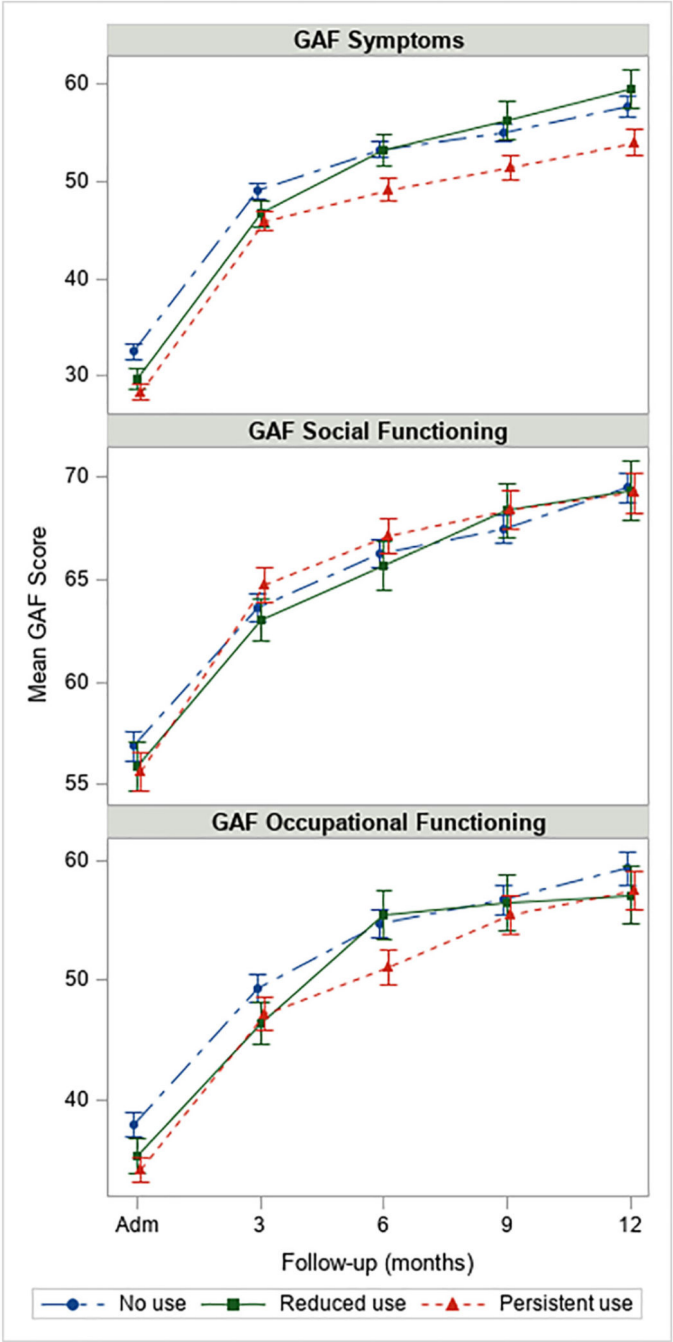

Fig. 1.

Observed mean GAF scores along with 1 standard error bars among participants in OTNY with 1-year eligibility (N = 938). *Note: y-axis varies by outcome*.

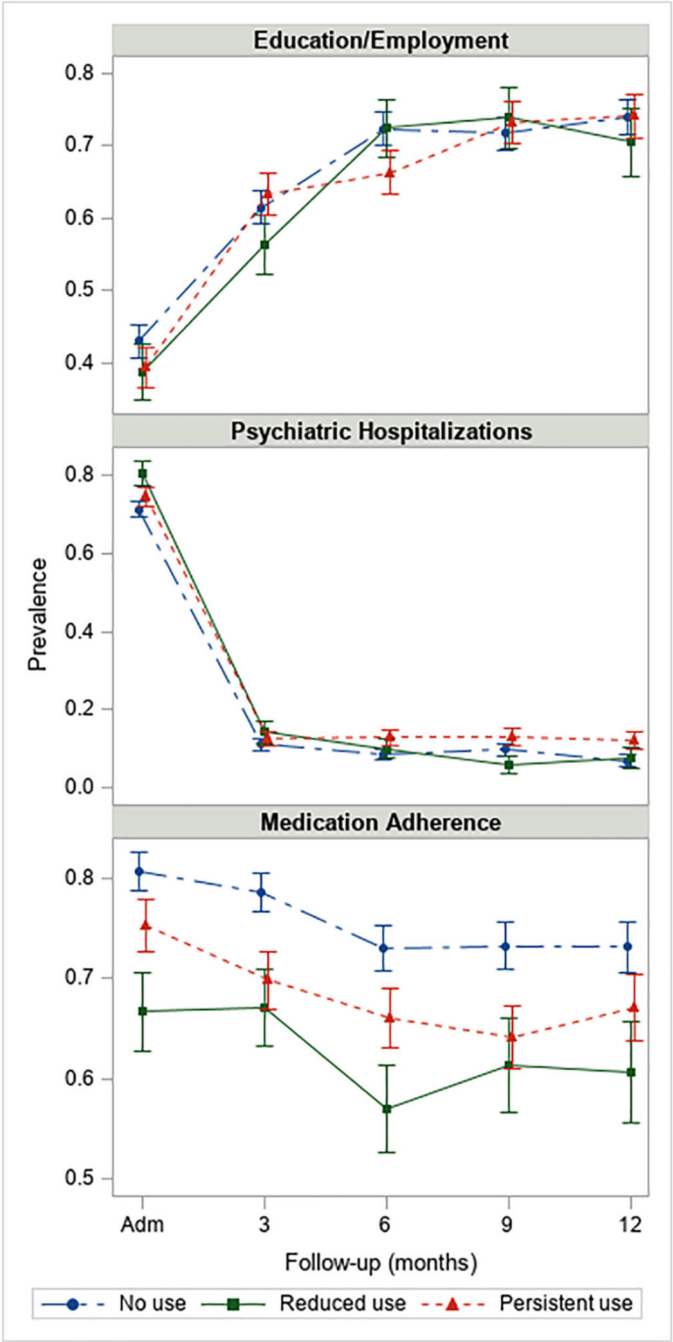

Fig. 2.

Observed rates of psychiatric hospitalizations, education/employment, and medication adherence along with 1-standard error bars among participants in OTNY with 1-year eligibility (N = 938). *Note: y-axis varies by outcome*.

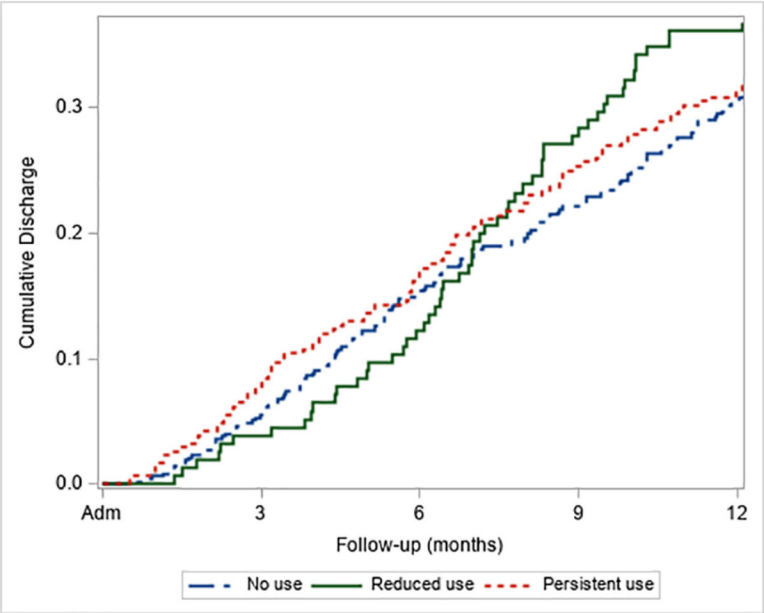

Fig. 3.

Cumulative incidence of early discharge by course of cannabis use among participants in OTNY with 1-year eligibility (N = 938).

Table 1

Participant characteristics at admission of the overall sample by course of cannabis use (N = 938).

			Course of cannabis use						Group comparisons				
	Overall (N = 938)		Group 1: no use (N = 475)		Group 2: reduced (N = 155)		Group 3: persistent (N = 308)		Overall difference		Pairwise: 1 vs 2	Pairwise: 1 vs 3	Pairwise: 2 vs 3
Measures	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**Test Statistic**	**p**	**p**	**p**	**p**
Demographic measures													
Age (years)	938	21.0 (3.3)	475	21.1 (3.5)	155	21.0 (2.9)	308	20.9 (2.9)	F(2, 935) = 0.39	0.676			
Gender									$\chi^2(4) = 21.72$	<0.001	0.014	<0.001	0.839
Female	236	25.2%	150	31.6%	30	19.4%	56	18.2%					
Male	697	74.3%	322	67.8%	124	80.0%	251	81.5%					
Other	5	0.5%	3	0.6%	1	0.6%	1	0.3%					
Race									$\chi^2(6) = 24.39$	<0.001	0.006	0.001	0.916
White (non-Hispanic)	253	27.0%	116	24.4%	46	29.7%	91	29.5%					
Black (non-Hispanic)	335	35.7%	158	33.3%	62	40.0%	115	37.3%					
Hispanic	258	27.5%	133	28.0%	40	25.8%	85	27.6%					
Other	92	9.8%	68	14.3%	7	4.5%	17	5.5%					
Insurance status									$\chi^2(6) = 7.13$	0.309			
Uninsured	48	5.1%	30	6.3%	7	4.5%	11	3.6%					
Public	430	45.8%	214	45.1%	71	45.8%	145	47.1%					
Private	383	40.8%	190	40.0%	70	45.2%	123	39.9%					
Other	77	8.2%	41	8.6%	7	4.5%	29	9.4%					
Social/family measures													
Homelessness									$\chi^2(2) = 4.99$	0.083			
No	885	94.3%	456	96.0%	143	92.3%	286	92.9%					
Yes	53	5.7%	19	4.0%	12	7.7%	22	7.1%					
Lives with family									$\chi^2(6) = 7.63$	0.267			
Parents	787	83.9%	408	85.9%	132	85.2%	247	80.2%					
Other family (not parents)	63	6.7%	28	5.9%	8	5.2%	27	8.8%					
Alone	41	4.4%	15	3.2%	7	4.5%	19	6.2%					

	Overall (N = 938)		Course of cannabis use						Group comparisons				
			Group 1: no use (N = 475)		Group 2: reduced (N = 155)		Group 3: persistent (N = 308)		Overall difference		Pairwise: 1 vs 2	Pairwise: 1 vs 3	Pairwise: 2 vs 3
Measures	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**Test Statistic**	**p**	**p**	**p**	**p**
Other	47	5.0%	24	5.1%	8	5.2%	15	4.9%					
Family contact									$\chi^2(4) = 2.26$	0.688			
Daily	842	90.8%	430	90.9%	141	91.6%	271	90.3%					
Weekly	60	6.5%	31	6.6%	7	4.5%	22	7.3%					
Monthly or less	25	2.7%	12	2.5%	6	3.9%	7	2.3%					
Legal issues									$\chi^2(2) = 7.68$	0.021	0.287	0.006	0.223
No	454	88.7%	233	92.1%	93	88.6%	128	83.1%					
Yes	58	11.3%	20	7.9%	12	11.4%	26	16.9%					
Clinical measures													
Time to OTNY (days)	937	170.0 (82.0–341.0)	474	175.5 (85.0–337.0)	155	149.0 (75.0–286.0)	308	180.0 (85.5–351.0)	$\chi^2(2) = 1.78$	0.412			
Age at onset of psychosis	937	20.9 (3.2)	474	21.0 (3.5)	155	20.9 (2.9)	308	20.8 (2.9)	F(2, 934) = 0.39	0.680			
Violent ideation/attempt									$\chi^2(2) = 8.17$	0.017	0.053	0.008	0.851
No	722	77.0%	384	80.8%	114	73.5%	224	72.7%					
Yes	216	23.0%	91	19.2%	41	26.5%	84	27.3%					
Suicide ideation/attempt									$\chi^2(2) = 6.19$	0.045	0.079	0.024	0.964
No	669	71.3%	356	74.9%	105	67.7%	208	67.5%					
Yes	269	28.7%	119	25.1%	50	32.3%	100						
Baseline tobacco use									$\chi^2(2) = 56.37$	<0.001	<0.001	<0.001	0.079
No	802	85.5%	445	93.7%	127	81.9%	230	74.7%					
Yes	136	14.5%	30	6.3%	28	18.1%	78	25.3%					
Baseline alcohol use									$\chi^2(2) = 87.04$	<0.001	<0.001	<0.001	0.012
No	703	74.9%	415	87.4%	84	54.2%	204	66.2%					
Yes	235	25.1%	60	12.6%	71	45.8%	104	33.8%					
Baseline other drug use									$\chi^2(2) = 44.85$	<0.001	<0.001	<0.001	0.073
No	884	94.2%	470	98.9%	133	85.8%	281	91.2%					
Yes	54	5.8%	5	1.1%	22	14.2%	27	8.8%					

	Overall (N = 938)		Course of cannabis use						Group comparisons				
			Group 1: no use (N = 475)		Group 2: reduced (N = 155)		Group 3: persistent (N = 308)		Overall difference		Pairwise: 1 vs 2	Pairwise: 1 vs 3	Pairwise: 2 vs 3
Measures	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**N**	**%, M (SD), Med (IQR)**	**Test Statistic**	**p**	**p**	**p**	**p**
Baseline outcome measures													
GAF symptoms	937	30.7 (14.9)	474	32.5 (15.9)	155	29.7 (13.1)	308	28.3 (13.7)	F(2, 934) = 7.81	<0.001	0.053	<0.001	0.282
GAF SF	934	56.3 (15.9)	472	56.9 (16.0)	155	55.9 (14.9)	307	55.7 (16.4)	F(2, 931) = 0.60	0.548			
GAF OC	933	36.2 (20.0)	472	37.9 (21.4)	155	35.3 (18.3)	306	34.1 (18.3)	F(2, 930) = 3.62	0.027	0.170	0.010	0.510
Education/employment									$\chi^2(2) = 1.45$	0.483			
No	553	59.0%	271	57.1%	95	61.3%	187	60.7%					
Yes	385	41.0%	204	42.9%	60	38.7%	121	39.3%					
Any psychiatric hospitalization									$\chi^2(2) = 5.34$	0.069			
No	244	26.0%	136	28.6%	30	19.4%	78	25.3%					
Yes	694	74.0%	339	71.4%	125	80.6%	230	74.7%					
Medication adherence									$\chi^2(6) = 14.54$	0.024	0.003	0.391	0.167
Not med adherent	139	14.8%	56	11.8%	36	23.2%	47	15.3%					
Med adherent	651	69.4%	346	72.8%	96	61.9%	209	67.9%					
Not prescribed meds	61	6.5%	27	5.7%	12	7.7%	22	7.1%					
Missing	87	9.3%	46	9.7%	11	7.1%	30	9.7%					
Early discharge prior to									$\chi^2(2) = 0.404$				
1 year No	634	67.6%	328	69.1%	98	63.2%	208	67.5%					
Yes	304	32.4%	147	30.9%	57	36.8%	100	32.5%					

Table 2

Results of longitudinal linear models on continuous clinical outcomes. Pairwise differences between course of cannabis use classes are shown at baseline, 12-month follow-up, and the change between baseline and 12 months. Overall joint tests were also computed for each set of pairwise comparisons.

	GAF Symptoms			GAF SF			GAF OC		
Pairwise differences	b	95% CI	p	b	95% CI	p	b	95% CI	p
At baseline									
Reduced vs persistent	1.14	(−2.05,4.33)	0.485	0.45	(−2.25, 3.14)	0.746	0.58	(−3.72, 4.87)	0.792
Reduced vs no use	−1.93	(−4.95,1.09)	0.211	0.55	(−2.01, 3.10)	0.675	−2.10	(−6.16,1.96)	0.311
Persistent vs no use	−3.06	(−5.45, −0.68)	0.012	0.10	(−1.92, 2.12)	0.921	−2.68	(−5.90, 0.54)	0.103
At 12 months									
Reduced vs persistent	5.33	(1.38, 9.29)	0.008	0.41	(−2.85, 3.68)	0.803	−0.29	(−5.56,4.97)	0.914
Reduced vs no use	1.95	(−1.81,5.70)	0.310	1.20	(−1.90, 4.30)	0.448	−1.94	(−6.93, 3.06)	0.447
Persistent vs no use	−3.39	(−6.26, −0.52)	0.021	0.79	(−1.59, 3.16)	0.517	−1.65	(−5.48, 2.19)	0.400
Change from BLto12 months									
Reduced vs persistent	4.20	(−0.69, 9.09)	0.093	−0.03	(−3.89,3.83)	0.988	−0.87	(−7.32, 5.59)	0.792
Reduced vs no use	3.87	(−0.74,8.49)	0.100	0.65	(−2.99, 4.30)	0.725	0.16	(−5.93, 6.25)	0.959
Persistent vs no use	−0.32	(−3.89, 3.24)	0.858	0.68	(−2.13, 3.50)	0.634	1.03	(−3.68, 5.74)	0.668
	GAF Symptoms			GAF SF			GAF OC		
Overall effects	F	df	p	F	df	p	F	df	p
Overall test at baseline	3.28	(2,3771)	0.038	0.09	(2,3763)	0.915	1.46	(2,3754)	0.232
Overall test at 12 months	4.35	(2,3771)	0.013	0.38	(2,3763)	0.683	0.49	(2,3754)	0.612
Overall test of change (12 m-BL)	1.61	(2,3771)	0.200	0.14	(2,3763)	0.872	0.10	(2,3754)	0.909

Table 3

Results of longitudinal logistic models on categorical clinical outcomes and of Cox-proportional hazards model on time to early discharge. Pairwise differences between course of cannabis use classes are shown at baseline, 12-month follow-up, and the change between baseline and 12 months. Overall joint tests were also computed for each set of pairwise comparisons.

	Education/employment			Psychiatric hospitalizations			Medication adherence			Time to early discharge		
Pairwise differences	Log- odds	95% CI	p	Log- odds	95% CL	p	Log- odds	95% CI	p	HR	95% CI	p
At baseline												
Reduced vs persistent	−0.04	(−0.45, 0.36)	0.841	0.39	(−0.10, 0.87)	0.117	−0.34	(−0.79, 0.12)	0.149	–	–	–
Reduced vs no use	−0.12	(−0.51, 0.26)	0.533	0.57	(0.12,1.03)	0.014	−0.60	(−1.04, −0.16)	0.008	–	–	–
Persistent vs no use	−0.08	(−0.38, 0.22)	0.602	0.19	(−0.14, 0.52)	0.263	−0.26	(−0.64, 0.11)	0.167	–	–	–
At 12 months												
Reduced vs persistent	−0.17	(−0.70, 0.36)	0.528	−0.54	(−1.37, 0.29)	0.204	−0.36	(−0.86, 0.14)	0.157	1.92	(0.99, 3.72)	0.052
Reduced vs no use	−0.20	(−0.70, 0.30)	0.438	0.18	(−0.67, 1.02)	0.683	−0.67	(−1.15, −0.20)	0.006	1.68	(0.92, 3.08)	0.090
Persistent vs no use	−0.03	(−0.43, 0.37)	0.892	0.72	(0.11,1.32)	0.020	−0.31	(−0.69, 0.07)	0.109	0.88	(0.51, 1.50)	0.629
Change from BLto12 months												
Reduced vs persistent	−0.13	(−0.78, 0.52)	0.693	−0.93	(−1.89, 0.04)	0.060	−0.02	(−0.69, 0.64)	0.946	–	–	–
Reduced vs no use	−0.08	(−0.69, 0.53)	0.805	−0.40	(−1.36, 0.56)	0.415	−0.07	(−0.71, 0.56)	0.823	–	–	–
Persistent vs no use	0.05	(−0.43,0.53)	0.829	0.53	(−0.16,1.21)	0.132	−0.05	(−0.57,0.47)	0.853	–	–	–
	Education/employment			Psychiatric hospitalizations			Medication adherence			Time to early discharge		
Overall effects	F	df	p	F	df	p	F	df	p	X^2	df	p
Overall test at baseline	0.25	(2, 2903)	0.777	3.14	(2,3014)	0.043	3.67	(2, 2804)	0.026	–	–	–
Overall test at 12 months	0.31	(2, 2903)	0.735	2.83	(2,3014)	0.059	4.06	(2, 2804)	0.017	4.12	2	0.128
Overall test of change (12 m-BL)	0.08	(2, 2903)	0.924	2.17	(2,3014)	0.115	0.03	(2, 2804)	0.969	–	–	–