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# The association of cannabis use with quality of life and psychosocial functioning in psychosis

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## ABSTRACT

**Background:** Cannabis use is highly prevalent among people with a psychotic disorder. They often report sociality, coping with unpleasant affect and having positive experiences as important reasons for cannabis use, suggesting that cannabis improves their quality of life (QoL) and psychosocial functioning. However, based on previous studies we hypothesize that cannabis use is negatively associated with long-term subjective QoL and psychosocial functioning in people with a psychotic disorder.

**Methods:** We included 2994 people with a psychotic disorder (36.4% female), mean age 44.4 (SD 11.9), mean illness duration 17.2 years (SD 11.1), who participated in two yearly routine outcome assessments between 2014 and 2018 (interval 9–15 months) from the naturalistic PHAMOUS cohort study. Linear regression analyses were used to examine whether first assessment cannabis use was associated with QoL (ManSA) and psychosocial functioning (HoNOS). Changes in outcomes between assessments were analyzed with AN(C)OVA, to examine differences between continuers (n = 255), discontinuers (n = 85), starters (n = 83) and non-users (n = 2571).

**Results:** At first assessment, 11.4% was using cannabis. They had lower QoL (B = -2.93, p < 0.001) and worse psychosocial functioning (B = 1.03, p = 0.002) than non-users. After one year, changes in QoL and psychosocial functioning were not significantly different between continuers, starters, discontinuers and non-users.

**Conclusions:** Cannabis users were less satisfied with their family relations and financial situation and showed more aggressive and disruptive behavior and self-harm than non-users. These differences are likely the result of patients having used cannabis for many years. Starting or discontinuing cannabis did not lead to changes in QoL and psychosocial functioning within one year.

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## 1. Introduction

People with a psychotic disorder often encounter difficulties in daily life, such as a low socioeconomic status, problems with maintaining a job or continuing education, a loss of social functioning resulting in loneliness and experiencing more negative emotions (Velthorst et al., 2017; Cho et al., 2017; Harrison and Gill, 2010; Bobes et al., 2010; Hooley, 2010). Risk factors such as cannabis use can contribute to these difficulties (Ringen et al., 2016). Cannabis is a commonly used

illicit drug among people with a psychotic disorder (Koskinen et al., 2009; Hunt et al., 2018). The prevalence of cannabis use among people with a psychotic disorder is approximately twice as high compared to the general population, with approximately 16% having a current and 27% having a lifetime cannabis use disorder (Koskinen et al., 2010).

The self-medication theory has been suggested as an explanation for the high prevalence of cannabis use in this population (Khantzian, 1985; Khantzian, 1997; Duncan, 1974). It was theorized that people with a psychotic disorder use illicit drugs in order to cope with their illness-related symptoms. Although some of these people have indeed reported alleviation of positive symptoms as reason for their cannabis use, they mostly reported other motivations such as feeling better, sociality and relaxation (Kolliakou et al., 2015; Gómez Pérez et al., 2014; Mané et al., 2015). Several studies have demonstrated that cannabis use mostly leads to a greater severity and persistence of psychotic symptoms instead of alleviation (Lowe et al., 2019; Bruins et al., 2016; Seddon et al., 2016; Henquet et al., 2010) as well as worse treatment outcomes (Reid and Bhattacharyya, 2019).

**Abbreviations:** ANOVA, analyses of variances; ANCOVA, analysis of covariances; HoNOS, Health of the Nation Outcome Scales; ManSA, Manchester Short Assessment of Quality of Life; PANSS, Positive and Negative Syndrome Scale; PHAMOUS, Pharmacotherapy Monitoring and Outcome Survey; QoL, quality of life.

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Although empirical evidence thus seems to suggest cannabis does not alleviate psychotic symptoms, the self-medication theory may apply to other illness-related areas. People with a psychotic disorder have indeed reported increasing sociality, coping with boredom and unpleasant affect, and experiencing positive feelings as important reasons for cannabis use (Kolliakou et al., 2015; Gómez Pérez et al., 2014; Mané et al., 2015; Green et al., 2004). This suggests that cannabis improves their subjective quality of life and psychosocial functioning, but this is not consistent with the literature.

Cannabis use has been found to lead to an immediate positive effect on mood (Henquet et al., 2010), but most studies have demonstrated that cannabis use is associated with a lower subjective quality of life (QoL) and worse psychosocial functioning (Seddon et al., 2016; Aspís et al., 2015; Lev-Ran et al., 2012; Fischer et al., 2015; Goldenberg et al., 2017; Clausen et al., 2014). However, these studies were limited to the general population (Fischer et al., 2015; Goldenberg et al., 2017), people with depressive (Aspís et al., 2015) and anxiety disorders (Lev-Ran et al., 2012), and first episode psychosis (Seddon et al., 2016; Clausen et al., 2014). Considering the relatively high prevalence of cannabis use among people with a chronic psychotic disorder, it is important to shed further light on the relation between cannabis use, QoL and psychosocial functioning in people with a psychotic disorder.

The current literature is unclear about the use of cannabis as self-medication to improve psychosocial functioning and QoL in people with a psychotic disorder. Our theory is that the finding that these people report improvements in sociality and QoL is caused by immediate and temporary effects of cannabis use, but that in the long-term cannabis use has the opposite effect. Therefore, we aim to examine the association of cannabis use with QoL and psychosocial functioning in a large, naturalistic follow-up cohort of people with a psychotic disorder. We hypothesize that frequent and long-term cannabis use is related to a lower QoL and worse psychosocial functioning. We will examine cross-sectional relations as well as changes in QoL and psychosocial functioning after one year in people who continued (continuers), discontinued (discontinuers), started (starters) or never used cannabis (non-users) between the two assessments. We will look at baseline differences between users and non-users and include these factors as possible confounders in the analyses.

## 2. Materials and methods

### 2.1. Subjects

Subjects in this study were participants of the Pharmacotherapy Monitoring and Outcome Survey (PHAMOUS). PHAMOUS is an ongoing naturalistic Dutch cohort study that started in 2006 in four mental health institutions in the northern Netherlands. Participants signed informed consent during their first assessment and specified whether or not their anonymized data may be used for scientific research. Assessments are carried out in accordance with the Declaration of Helsinki (October 2013) and local and international ethical standards, as confirmed by the ethical committee of the University Medical Center of Groningen in the Netherlands. People participate on a voluntary basis. Currently, approximately 2000 participants per year are assessed (Bartels-Velthuis et al., 2018). People with a psychotic disorder and/or who are prescribed antipsychotic medication are invited to participate in annual screenings for health evaluation purposes, with trained nurses examining their mental and physical health. Approximately 70% of the people receiving care in a participating mental health institution are both willing and able to participate in PHAMOUS screenings (i.e. the severity of their psychotic symptoms does not obstruct participation).

Subjects were included in the current study when: (I) they had a diagnosis of a psychotic disorder at the first assessment (i.e. schizophrenia, schizoaffective disorder, schizophreniform disorder, delusional disorder, substance induced psychosis or psychosis NOS), (II) they participated in two consecutive assessments between 2014 and 2018, with

an interval between 9 and 15 months, (III) they disclosed at both assessments whether or not they were using cannabis, and (IV) they had available data on at least one of the outcome measures (QoL, psychosocial functioning).

At the first assessment, participants were divided in current users and non-users. At the second assessment participants were categorized in four different groups: continuers (using cannabis at both assessments), discontinuers (using cannabis at the first, but not using cannabis at the second assessment), starters (not using cannabis at the first, but using cannabis at the second assessment) and non-users (not using cannabis at either assessment).

### 2.2. Measures

The PHAMOUS database contained sociodemographic and clinical characteristics (i.e. diagnosis, illness duration and symptom severity), use of medication and substances (e.g. cannabis), and social outcomes (i.e. QoL and psychosocial functioning). Cannabis use, smoking and alcohol use were registered as a dichotomous variable (yes/no) based on self-report over the past month. Participants were also asked about the frequency of their cannabis use in number of joints per week. Since no further other information about dose or type of cannabis plant was available, we opted to only use the status of cannabis use in our analyses.

QoL was measured with the self-report questionnaire Manchester Short Assessment of Quality of Life (ManSA) (Priebe et al., 1999; Björkman and Svensson, 2005), specifically developed for people in mental health care. Twelve items about satisfaction with life on a 7-point Likert-scale from 1 (cannot be worse) to 7 (cannot be better) made up the main score that was included as QoL in the analysis, with higher scores indicating a better QoL. Four additional dichotomous questions assessing crime and friendship were analyzed separately.

Psychosocial functioning was measured with the Health of the Nation Outcome Scales (HoNOS) (Wing et al., 1998). Attending clinicians were offered a HoNOS training and rated twelve items on a 5-point Likert scale, ranging from 0 (no problem) to 4 (severe or very severe problem). Items were distributed across four subscales: Behavior (i.e. aggressive, disruptive behavior, self-harm and substance abuse), Impairments (i.e. cognitive and physical impairments), Symptoms (i.e. problems with hallucinations and delusions, mood and other mental problems) and Social (i.e. problems with relationships, daily living, living conditions and occupation). Higher scores represented worse psychosocial functioning. We analyzed both the total score and the four subscales separately. Of note, item 3 on the HoNOS scale comprises substance use, both alcohol and drugs, and is part of the Behavioral subscale and total score. As such, cannabis use is both predictor and part of the outcome, which complicates interpretations. We therefore performed our analyses with an adjusted total HoNOS score and Behavioral subscale, where the substance use item is left out.

Psychotic symptom severity was assessed with the Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987). The assessor scored 30 items on a 7-point Likert-scale, ranging from 1 (symptom is absent) to 7 (symptom is severe). The items were divided into a Positive symptoms subscale (e.g. delusions and hallucinations), Negative symptoms subscale (e.g. social/emotional withdrawal) and a General Psychopathology subscale (e.g. anxiety and disorientation).

### 2.3. Data analysis

The prevalence of specific demographic characteristics among cannabis users and non-users was compared using Chi-square statistics and two-tailed *t*-test analyses. All factors that tested significantly different between cannabis users and non-users at the first assessment were included as covariates in the analyses (i.e. age, illness duration, gender, PANSS Positive symptoms subscale, diagnosis schizophrenia, Afro-European ethnicity, smoking and alcohol use). The associations

between cannabis use and mean ManSA and HoNOS scores were examined using multiple linear regressions, with corrections for significant covariates and multiple testing (Bonferroni).

Next, we examined whether changes in cannabis use were associated with changes in QoL and psychosocial functioning by including a second assessment after a 9–15 month interval. Participants were categorized into four groups based on cannabis use: continuers, discontinuers, starters and non-users. Analyses of variances (ANOVA) were used to examine any differences in changes from the first to second assessment in ManSA and HoNOS scores between the four participant groups. When the overall ANOVA was significant, we performed a priori planned comparisons between continuers vs. discontinuers and non-users vs. starters. Subsequently, separate univariate ANCOVA models were fitted for the significant outcomes, corrected for multiple testing (Bonferroni) and the confounding influence of covariates identified at the first assessment, with smoking status (continued, discontinued, starter, non-smoker) and alcohol-use status (continued, discontinued, starter, non-drinker) as measured at the second assessment.

All analyses were performed using IBM SPSS 26.0. Given the large sample size, significance was tested at  $\alpha = 0.01$  level to account for potential overpowering.

### 3. Results

Of the  $n = 9070$  people with any assessment in the PHAMOUS database since 2014,  $n = 2994$  participants met all inclusion criteria. Illness duration ranged from 1 to 68 years with 87.4% having an illness duration of at least 5 years. The first assessment values of the included sample were comparable with the overall PHAMOUS population with regard to age ( $M = 45.1, SD = 12.0$ ), gender (34.2% female), illness duration ( $M = 17.9, SD = 11.5$ ), diagnosis of schizophrenia (61.8%) and cannabis use (13.7%) (Bartels-Velthuis et al., 2018). At the first assessment, 11.4% of participants reported to currently use cannabis. Almost half of these people (49.9%) used up to 7 cannabis joints weekly, 12.6% used 7 to 14 joints weekly, 15.9% used 14 or more joints weekly and 22.1% did not disclose the frequency of their cannabis use. Average

duration of cannabis use was 19.9 years ( $SD = 11.1$ ), with the majority of the current users having used cannabis for at least 10 years (57.1%). Of note, 21.3% of the non-users reported to have used cannabis in the past, but not being a current user.

Compared to non-users, the cannabis users were younger, more often male, had a shorter illness duration and more severe positive symptoms of psychosis, were more often diagnosed with schizophrenia, more likely to be Afro-European and more likely to smoke cigarettes and drink alcoholic beverages (see Table 1).

#### 3.1. Association with quality of life (ManSA)

Linear regression analyses on the data of the first assessment showed that cannabis use was associated with significantly lower total ManSA scores ( $B = -2.93, 95\% CI = -4.45: -1.41, p < 0.001$ ), indicating lower QoL in cannabis users. This association between cannabis use and ManSA scores remained significant after correcting the model for the covariates age, gender, illness duration, severity of positive symptoms (PANSS Positive subscale), diagnosis of schizophrenia, Afro-European ethnicity, smoking and alcohol use ( $B = -3.24, 95\% CI = -5.51: -0.97, p = 0.005$ ).

More specifically, cannabis use at the first assessment was associated with less satisfaction with family relationships ( $B = -0.46, 95\% CI = -0.77: -0.17, p = 0.002$ ) and worse financial situation ( $B = -0.91, 95\% CI = -1.24: -0.58, p < 0.001$ ), corrected for multiple testing (Bonferroni) and covariates. Details are presented in Table 2. Notably, linear regression analyses showed that frequency of use was also negatively related to satisfaction with family relationships ( $B = -0.19, 95\% CI = -0.03: -0.01, p = 0.003$ ) and financial situation ( $B = -0.29, 95\% CI = -0.04: -0.02, p < 0.001$ ) at the first assessment. Chi-squared analyses of the first assessment data demonstrated that cannabis users were also more likely to be accused of criminal behavior (odds ratio = 2.71, 95% CI = 1.67: 4.41) and to have contacted a friend the past week (odds ratio = 1.61, 95% CI = 1.19: 2.18) than non-users.

Analyses of variances (ANOVA) on the change in ManSA scores from the first to second assessment showed neither a statistically significant difference in overall ManSA scores between the four groups ( $F = 0.54,$

**Table 1**  
Differences between cannabis users and non-users at the first assessment.

	Total n = 2994	Cannabis users n = 340	Non-users n = 2654	p
<b>Demographic characteristics</b>				
Age, years M (SD)	44.4 (11.9)	39.8 (10.4)	45.1 (11.9)	<0.001**
Gender, % female (n)	36.4 (n = 1089)	11.5 (n = 39)	39.6 (n = 1050)	<0.001**
Illness duration, years M (SD)	17.2 (11.1)	14.8 (9.1)	17.5 (11.3)	<0.001**
<b>Ethnicity</b>				
Caucasian, % (n)	89.6 (n = 2680)	86.2 (n = 293)	90.0 (n = 2387)	0.030
Afro-European	4.4 (n = 133)	7.6 (n = 26)	4.0 (n = 107)	0.002*
Asian	2.4 (n = 72)	1.8 (n = 6)	2.5 (n = 66)	0.412
Other	3.6 (n = 107)	4.4 (n = 15)	3.5 (n = 92)	0.378
<b>Diagnosis</b>				
Schizophrenia, % (n)	64.7 (n = 1937)	73.5 (n = 250)	63.6 (n = 1687)	<0.001**
Schizophreniform disorder	1.7 (n = 51)	0.9 (n = 3)	1.8 (n = 48)	0.214
Schizoaffective disorder	15.4 (n = 460)	10.6 (n = 36)	16.0 (n = 424)	0.009*
Substance-induced psychosis	0.7 (n = 21)	1.2 (n = 4)	0.6 (n = 17)	0.265
Other	17.5 (n = 525)	13.8 (n = 47)	18.0 (n = 478)	0.000
PANSS total score, M (SD)	40.4 (19.6)	43.4 (20.82)	40.1 (19.4)	0.007*
PANSS Positive symptoms	10.0 (4.8)	11.0 (5.1)	9.8 (4.8)	<0.001**
PANSS Negative symptoms	11.4 (5.8)	11.9 (6.3)	11.4 (5.8)	0.163
PANSS General Psychopathology	19.2 (11.4)	20.5 (12.1)	19.0 (11.3)	0.034
<b>Medication and substance use</b>				
Antipsychotic drug use, % (n)	86.7 (n = 2596)	83.2 (n = 283)	87.2 (n = 2313)	0.045
Antidepressant drug use, % (n)	27.7 (n = 830)	24.1 (n = 82)	28.3 (n = 748)	0.115
Anxiolytic drug use, % (n)	26.5 (n = 793)	27.6 (n = 94)	26.3 (n = 699)	0.606
Smoking status, % yes (n)	69.0 (n = 1330)	97.3 (n = 219)	65.2 (n = 1111)	<0.001**
Alcohol use, % yes (n)	40.2 (n = 1191)	63.3 (n = 212)	37.3 (n = 979)	<0.001**

\*Significant at 0.01 level. \*\*Significant at 0.001 level.

**Table 2**  
Adjusted differences in quality of life and social functioning at the first assessment.

	Cannabis users	Non-users	F/Chi <sup>2</sup>	p
	n = 340	n = 2654		
	M (SD)	M (SD)		
ManSA total score, M (SD)	56.4 (12.1)	59.4 (11.8)	7.18	0.007*
Victim of violence % (n)	8.5 (n = 23)	5.1 (n = 113)	5.49	0.019
Accused of crime % (n)	8.4 (n = 23)	3.3 (n = 73)	17.41	<0.001**
Having a good friend % (n)	77.6 (n = 211)	74.4 (n = 1652)	1.28	0.258
Spoken with a friend past week % (n)	78.3 (n = 213)	69.2 (n = 1531)	9.70	0.002*
Satisfaction with...M (SD)				
Life as a whole	4.9 (1.5)	4.7 (1.5)	1.30	0.255
Living environment	5.3 (1.6)	5.5 (1.5)	0.47	0.493
Living situation (alone or with others)	5.1 (1.6)	5.3 (1.5)	2.76	0.097
Daily activities	4.9 (1.5)	5.1 (1.5)	3.50	0.062
Physical health	4.6 (1.6)	4.7 (1.6)	2.63	0.105
Psychological health	4.6 (1.6)	4.6 (1.6)	0.22	0.636
Personal safety	5.3 (1.5)	5.4 (1.4)	3.01	0.083
Social relationships	4.7 (1.5)	4.8 (1.6)	2.09	0.148
Family relationships	5.0 (1.7)	5.3 (1.5)	8.54	0.004*
Intimate relationships	4.4 (1.8)	4.8 (1.7)	1.42	0.234
Sexual life	4.0 (1.8)	4.3 (1.8)	0.00	0.992
Financial situation	3.8 (1.8)	4.8 (1.7)	28.47	<0.001**
HoNOS total score (adjusted) <sup>a</sup> , M (SD)	9.8 (5.1)	8.7 (5.3)	9.71	0.002*
Behavior (adjusted) <sup>a</sup>	0.7 (0.9)	0.5 (0.9)	7.56	0.006*
Impairments	1.8 (1.4)	1.9 (1.6)	0.24	0.624
Symptoms	3.5 (2.1)	3.3 (2.3)	0.04	0.849
Social	3.8 (2.8)	3.1 (2.5)	3.16	0.076

\*Significant at 0.01 level. \*\*Significant at 0.001 level.

MANSA = Manchester Short Assessment of Quality of Life (higher scores = more Quality of Life). HoNOS = Health of the Nation Outcome Scales (higher scores = worse psychosocial functioning). M = Mean. SE = Standard Error.

Covariates included in the model: gender, age (M = 44.4), illness duration (M = 17.2), PANSS Positive (M = 10.0), diagnosis schizophrenia, Afro-European ethnicity, smoking and alcohol use.

<sup>a</sup> HoNOS item 3 'Substance Use' is left out.

p = 0.653), nor on item-level (see Table 3). Therefore the planned contrast analyses were ignored. Chi-squared analysis of the second assessment data demonstrated that continuers and starters did have a greater chance of being a victim of violence (odds ratio = 1.87, 95% CI: 1.14–3.09), being accused of criminal behavior (odds ratio = 3.38, 95% CI = 2.04: 5.62) and were more likely to have contacted a friend the past week (odds ratio = 1.54, 95% CI = 1.13: 2.11) than discontinuers and non-users.

### 3.2. Association with psychosocial functioning (HoNOS)

Linear regression analyses on the data of the first assessment showed that cannabis use was significantly associated with the adjusted total HoNOS score (minus substance abuse item) at the first assessment (B = 1.03, 95%CI = 0.38: 1.68, p = 0.002), indicating worse psychosocial functioning in cannabis users. However, the association between cannabis use and adjusted HoNOS was no longer significant after Bonferroni correction and including the covariates age, gender, illness duration, severity of positive symptoms (PANSS Positive subscale), diagnosis schizophrenia, Afro-European ethnicity, smoking and alcohol use (B = 0.62, 95%CI = -0.22: 1.47, p = 0.149).

Specifically, cannabis use was significantly associated with more problems on the adjusted Behavior subscale at the first assessment (B = 0.25, 95%CI = 0.14: 0.35, p < 0.001), which remained significant after correction for covariates and multiple testing (B = 0.20, 95%

CI = 0.05: 0.34, p = 0.007). An overview is presented in Table 2. Furthermore, linear regression analyses showed that frequency of cannabis use was also positively related to the overall HoNOS scores (B = 0.90, 95% CI = 0.05: 0.13, p < 0.001) and Behavior subscale (B = 0.73, 95% CI = 0.06: 0.08, p < 0.001).

Analyses of variances (ANOVA) on the changes in HoNOS scores from the first to second assessment demonstrated that there were neither differences between the four groups in the adjusted total HoNOS scores (F = 0.12, p = 0.946) nor at the subscale level (see Table 3).

## 4. Discussion

In this study, we longitudinally examined whether cannabis use in people with a psychotic disorder was associated with worse subjective QoL and psychosocial functioning. Indeed, at the first assessment cannabis users had a lower QoL and worse psychosocial functioning. This was demonstrated by less satisfaction with their family relations and financial situation, and with more aggressive and disruptive behavior and self-harm than non-users. These findings correspond to findings of previous studies in the general population (Fischer et al., 2015; Goldenberg et al., 2017) and in other psychiatric disorders (Seddon et al., 2016; Aspis et al., 2015; Lev-Ran et al., 2012; Clausen et al., 2014). However, at the second assessment after approximately one year, change scores in QoL and psychosocial functioning were not significantly different between continuers, discontinuers, starters and non-users of cannabis.

Analyses at both assessments further showed that starters and continuers were more often both victim and perpetrator of a crime. This is in line with several other studies reporting that cannabis use was positively associated with crime and violence, in a variety of populations and settings (Dharmawardene and Menkes, 2017; Norström and Rossow, 2014; Friedman et al., 2001). Increased exposure to violence and crime is commonly associated with the substance use milieu (de Vries et al., 2018). Of note, purchase and possession of cannabis for personal use is legal in the Netherlands, therefore cannabis use in itself is not considered criminal behavior. Furthermore, starters and continued users were more likely to have had social contacts during the past week. These could be regular contacts with friends and family, in which case this could be an indication of increased sociality (Kolliakou et al., 2015; Gómez Pérez et al., 2014). However, it could also be related to the substance use scene, where users have contact with their suppliers (Mason et al., 2017).

Notably, QoL (here measured in how satisfied a person is with certain areas of their life) and psychosocial functioning are comprehensive constructs that usually do not show measurable changes within a short time span. Even a psychosocial intervention specifically aimed at improving QoL and psychosocial functioning in schizophrenia only started showing effects during a follow-up assessment, one year after the intervention had ended, and not right at the end of the nine-month treatment (Pec et al., 2018). The majority of the cannabis users in our study had been longtime users (>10 years) and the discontinuers had only ceased their cannabis use from minimally one week until maximally 15 months before the second assessment, which may be too short a follow-up. Considering the severity of cannabis use in our sample, the differences in QoL and psychosocial functioning at the first assessment are likely the result of many years of cannabis use (Volkow et al., 2014; Brook et al., 2013). Therefore, more time after starting or discontinuing cannabis use is likely needed before changes in overall QoL and psychosocial functioning can be detected. As a result of this slow progression of change in these areas, it is possible that people do not attribute these negative changes to their cannabis use. Instead, the acute mood-enhancing effect of cannabis (Henquet et al., 2010) might shape and consolidate their positive perception of the substance.

Furthermore, causality cannot be determined for the cross-sectional associations that have been found. It is possible that the differences in QoL and psychosocial functioning between users and non-users are not the result of cannabis use, but that cannabis use instead is a marker

**Table 3**

Differences in ManSA and HoNOS change scores from first to second assessment between continuers, discontinuers, starters and non-users of cannabis.a

	Continuers n = 255	Discontinuers n = 85	Starters n = 83	Non-users n = 2571	F/Chi <sup>2</sup>	p
	M (SD)	M (SD)	M (SD)	M (SD)		
ManSA total, Mean change (SD)	0.2 (10.0)	1.9 (12.2)	−0.4 (13.5)	0.6 (9.5)	0.54	0.653
Victim of violence % (n)	6.3 (n = 12)	6.3 (n = 4)	13.3 (n = 8)	4.4 (n = 91)	11.72	0.008*
Accused of crime % (n)	7.8 (n = 15)	6.3 (n = 4)	11.7 (n = 7)	2.6 (n = 55)	29.44	<0.001**
Having a good friend % (n)	80.8 (n = 156)	66.7 (n = 42)	71.7 (n = 43)	75.9 (n = 1585)	6.10	0.107
Spoken with a friend past week % (n)	79.3 (n = 153)	69.8 (n = 44)	75.0 (n = 45)	70.0 (n = 1458)	7.85	0.049
Satisfaction with... Mean change (SD)						
Life as a whole	0.0 (1.5)	−0.1 (1.6)	0.2 (2.0)	0.0 (1.4)	0.37	0.776
Living environment	0.0 (1.6)	−0.1 (1.6)	0.3 (1.8)	0.0 (1.4)	0.68	0.562
Living situation (alone or with others)	0.0 (1.7)	0.0 (1.9)	0.0 (2.1)	0.1 (1.5)	0.05	0.984
Daily activities	0.1 (1.7)	−0.1 (1.9)	−0.2 (1.8)	0.0 (1.5)	0.70	0.555
Physical health	0.0 (1.5)	0.2 (1.8)	−0.1 (1.8)	0.1 (1.6)	0.25	0.864
Psychological health	0.2 (1.6)	0.1 (1.5)	−0.1 (1.9)	0.1 (1.5)	0.40	0.756
Personal safety	0.1 (1.3)	0.0 (1.6)	0.0 (1.5)	0.1 (1.3)	0.23	0.874
Social relationships	0.0 (1.6)	0.1 (1.7)	−0.1 (2.0)	0.1 (1.5)	0.34	0.794
Family relationships	−0.1 (1.5)	0.5 (2.2)	−0.1 (1.7)	0.0 (1.4)	3.18	0.024
Intimate relationships	−0.1 (1.8)	0.5 (2.3)	−0.2 (1.9)	0.0 (1.7)	2.13	0.095
Sexual life	−0.1 (1.9)	0.0 (2.0)	−0.2 (1.9)	0.0 (1.7)	0.46	0.710
Financial situation	0.2 (1.7)	0.3 (1.7)	−0.1 (2.1)	0.0 (1.6)	0.78	0.508
HoNOS total (adjusted) <sup>a</sup> , Mean change (SD)	−0.3 (4.7)	−0.6 (5.2)	−0.5 (5.9)	−0.3 (4.5)	0.12	0.946
Behavior (adjusted) <sup>a</sup>	0.0 (0.9)	0.0 (1.1)	0.2 (1.5)	−0.1 (0.9)	1.47	0.220
Impairments	0.0 (1.3)	−0.3 (1.7)	0.2 (1.6)	−0.0 (1.4)	1.00	0.393
Symptoms	0.1 (2.2)	−0.4 (2.4)	−0.3 (2.6)	−0.2 (2.1)	0.92	0.429
Social	−0.3 (2.5)	−0.3 (2.5)	−0.3 (2.9)	−0.1 (2.3)	0.86	0.461

\*Significant at 0.05 level. \*\*Significant at 0.001 level.

MANSA = Manchester Short Assessment of Quality of Life. HoNOS = Health of the Nation Outcome Scales. M = Mean. SD = Standard Deviation.

<sup>a</sup> HoNOS item 3 'Substance Use' is left out.

of poor QoL and poor psychosocial functioning. This would also explain why discontinuing cannabis use did not lead to changes in QoL and psychosocial functioning. Similarly, our data does not provide information about the moment and reasons why people in this study started or discontinued using cannabis.

#### 4.1. Strengths and limitations

The large sample size and longitudinal observational nature of the PHAMOUS cohort provides generalizable insight into the clinical picture of people with a psychotic disorder. However, selection bias may be present, as PHAMOUS participants generally have a long illness duration, are still receiving care and have to be willing to participate in annual screenings.

Prevalence of cannabis use was relatively low compared to other samples and specific information about the used cannabis was limited. There was neither detailed information about the amount of cannabis grams per joint, nor about the compounds of the cannabis plant, which would have been useful since different components and doses of cannabis can have different effects (Solowij et al., 2019; Freeman et al., 2018; Izzo et al., 2009).

Since it is unknown what happened during the time between assessments and when people exactly discontinued or started using, we cannot be sure whether discontinuing or starting cannabis use preceded or followed changes in QoL or psychosocial functioning, or perhaps psychotic symptom severity. It is possible that, for example, participants experienced an increase in psychotic symptoms and therefore started using cannabis, in which case cannabis use would be a result rather than the cause of increased symptom severity. This seems however unlikely, as a previous study in the PHAMOUS database showed a group-level decrease in psychotic symptom severity (hallucinations and delusions) in discontinuers and an increased symptom severity in starters (Bruins et al., 2016). Moreover, it is possible that changes in various outcomes were underestimated, because some participants had only started or discontinued cannabis for a short time. This could explain why we did not find statistically significant differences between

discontinuers and starters in changes in QoL and overall psychosocial functioning at the second assessment.

Information about cannabis use was based on self-report. It is possible that participants had a tendency to give socially desirable answers, which means (the amount of) cannabis use could be underestimated in this study. However, self-reported and objective measures of cannabis use are generally equally reliable in people with a psychotic disorder (van der Meer et al., 2015).

It is not uncommon that cannabis is used in combination with other illicit drugs (Ryan et al., 2020). Unfortunately, no information regarding the use of (illicit) substances in our sample were available other than alcohol, smoking and cannabis use.

#### 4.2. Conclusion

Cannabis users with a psychotic disorder were less satisfied with their family relations and financial situation and showed more aggressive and disruptive behavior and self-harm than people with a psychotic disorder who do not use cannabis. Our findings suggests that these differences are likely the result of people having used cannabis for many years, although causality cannot be proven with this study. Changing cannabis use (starting or discontinuing) did not lead to changes in QoL and psychosocial functioning within one year. It is possible that changes will follow after a longer period of starting/discontinuing, and it is worth investigating this in future research.

#### Contributors

JB and EV prepared, analyzed and interpreted the data. GHMP and SC were major contributors in designing the study and writing the manuscript. AAB-V, RB, FJ, HK, WV and LW are major contributors to the ROM-PHAMOUS program and were major contributors in writing the manuscript. All authors read and approved the final manuscript.

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**Declaration of competing interest**

All authors declare that they have no conflict of interest.

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