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For better or for worse? A pre–post exploration of the impact of the COVID-19 lockdown on cannabis users

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ABSTRACT

Background and aims Lockdown measures aimed at limiting the number of infections and deaths from the coronavirus disease 2019 (COVID-19) have introduced substantial psychosocial stressors in everyday life. We aimed to investigate the influence of the Dutch lockdown on cannabis use and cannabis use disorder (CUD) and investigate relations with change in mental wellbeing and experienced psychosocial stressors during the lockdown. **Design** Explorative longitudinal baseline-, pre- and during lockdown survey study. **Setting** The Netherlands, on-line between January 2019 and May 2020. **Participants** Community sample of 120 monthly to daily cannabis users and reference group of 63 non-using controls. **Measurements** Change in cannabis use and CUD symptom severity from baseline to pre- to post-lockdown. Change in cannabis use motives, mental health, quality of social relationships and job status from pre- to post-lockdown. **Findings** In cannabis users, lockdown related to increased cannabis use [$B = 1.96$, 95% confidence interval (CI) = 0.26–3.66, $P = 0.024$], but not CUD symptom severity. Cannabis users experienced 30% job loss and increased loneliness [$P < 0.001$, Bayes factor $(BF)_{10} > 100$], while contact with partners ($P = 0.005$, $BF_{10} = 8.21$) and families improved ($P < 0.001$, $BF_{10} = 19.73$), with no differences between cannabis users and control. Generally, mental health problems (all $Ps > 0.277$, all $BF_{10} < 0.139$) did not change, but individual differences were significant and severity of cannabis use pre-lockdown, COVID-19-related worries, change in anxiety, expansion motives, social motives and family contact all uniquely related to variance in change in cannabis use or CUD. **Conclusions** While cannabis use among daily cannabis users in the Netherlands increased at the group level during the period of COVID-19 lockdown, the effect of the first months of lockdown on cannabis use disorder severity and mental wellbeing varied significantly among individual daily cannabis users.

Keywords Cannabis, cannabis use disorder, cannabis use motives, COVID-19, mental health, social relationships.

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INTRODUCTION

The social distancing measures aimed at limiting the number of infections and deaths from the novel SARS-CoV-2 virus and associated coronavirus disease 2019 (COVID-19) have introduced substantial psychosocial stressors in everyday life, raising concerns regarding the wellbeing of vulnerable populations, including substance users [1,2]. The current explorative study assessed the influence of the Dutch lockdown initiated in March 2020 on cannabis use and cannabis use disorder (CUD) severity in a community sample of monthly to daily cannabis users. Furthermore, we investigated if individual change in use and CUD symptoms was related to change in mental wellbeing and experienced psychosocial stressors during the lockdown.

The Dutch lockdown measures involved social isolation and prolonged confinement at home, including work and school from home. Pandemic-specific anxieties have emerged in the population, with increased levels of worry concerning personal health and economic consequences [3]. Sudden job loss and unemployment have also been an unfortunate reality for many, particularly individuals who work in the retail and food services, culture, accommodation and cleaning sectors [4]. Moreover, emerging evidence suggests a 16–28% increase in anxiety

and depression symptoms and an 8% increase in self-reported stress in the general population [5]. The increase in experienced stressors and mental health problems, combined with the reduction in alternative positive activities, have led to substantial concern from the scientific community concerning the potential impact on vulnerable populations such as substance users [1,2]. From previous research on the effects of economic crises on substance use (e.g. the 2008 global recession), we know that high rates of job loss are associated with increased substance use and addiction, especially in young men [6]. Job loss is a demonstrated risk factor for cannabis use, and unemployed young adults in particular have higher rates of developing a CUD [7,8]. CUD is also highly comorbid with anxiety and depression [9,10], and stress is an important factor in the escalation of use, development of addiction and relapse [11,12]. Particularly in regular cannabis users, stress and tension reduction are commonly reported motives for use [13], correlating with CUD severity [14].

To our knowledge, previous studies have only cross-sectionally investigated the effect of the virus and lockdown on cannabis use. Increases in cannabis use have been reported in medical cannabis users from the United States [15], adult recreational cannabis users in France [16] and adolescent recreational users from Canada [17]. In contrast, a survey conducted among the general population in Belgium reported no increase in use [18]. These studies suggest that cannabis use may have increased during the lockdown period. To build upon this, the main aim of this exploratory study was to (i) investigate if lockdown was associated with change in cannabis use and CUD symptom severity in cannabis users. We invited a unique sample of cannabis users and non-cannabis-using controls who completed a survey about their cannabis use prior to the pandemic (baseline) to complete an on-line survey about cannabis use just before (pre-lockdown) and since lockdown (post-lockdown) and other socio-psychological consequences of the lockdown. The second aim was to (ii) investigate if pre- to post-lockdown change in cannabis use and CUD symptom severity related to change in cannabis use motives, mental wellbeing, quality of social relationships and job status. For reference, we checked (iii) if changes observed in cannabis users differed from changes observed in a smaller group of non-cannabis-using controls. Given the unique nature of the lockdown, all analyses were exploratory. However, we expected a general increase in cannabis use and CUD symptom severity pre- to post-lockdown [16] that related to decreases in general mental wellbeing. We also expected that increases in cannabis use and CUD symptoms would relate to increases in cannabis coping motives [14], decreases in social relationship quality [19,20] and job loss [7,8].

MATERIALS AND METHODS

Participants

Study protocols were approved by the Ethics Review Board of the Faculty of Social and Behavioral Sciences, University of Amsterdam (2020-DP-12211). Individuals who completed an eligibility screener for a different CUD study and agreed to be contacted for future studies were invited to participate. Individuals were originally recruited using social media advertising and in-person flyers targeted at daily or near-daily cannabis users and non-using controls (< 25 life-time uses) who do not regularly use other illicit substances. Of the 1030 invited individuals, 186 agreed to participate in this new study, for which they completed the follow-up survey and consented to merging the screening data with the follow-up survey. Among those, €8 × 25 on-line shop vouchers were raffled. Three participants were excluded due to daily other substance use [one control for daily gamma hydroxybutyrate (GHB) use, one control for regular use of multiple illicit drugs other than cannabis and one cannabis user for daily methamphetamine use]. The final sample consisted of 120 cannabis users aged 18–46 years who reported monthly to daily cannabis use before lockdown (baseline and/or pre-lockdown) and, for reference, a group of 63 sporadic to non-cannabis-using controls aged 18–31 years.

Questionnaires

The onset of the Dutch lockdown began on 12 March 2020. Each participant completed a baseline and follow-up questionnaire. The baseline questionnaire was completed, on average, 265 days [standard deviation (SD) = 144.4; range = 26–467 days] prior to the lockdown and assessed use of cannabis and other substances. The follow-up questionnaire contained retrospective questions concerning the period before (pre-lockdown) and during lockdown (post-lockdown) and was conducted, on average, 59 days (SD = 8.6, range = 47–79) after the lockdown began, before any regulations were loosened (see Figure S1). Table 1 shows an overview of the substance use measures collected for the baseline, pre- and post-lockdown periods. Table 2 shows an overview of all other measures collected at follow-up. The assessment time-frames for each participant are shown in Supporting information, Fig. S1.

Cannabis use and CUD symptom severity

Our main outcome variables were DSM-5 CUD symptom severity and cannabis use. DSM-5 CUD symptoms were assessed with the MINI version 7.0.0 DSM-5 CUD section [21] for the previous year in weekly users at baseline (Cronbach's α = 0.86), and for the previous year pre-lockdown (Cronbach's α = 0.83) and the period since

Table 1 Overview of alcohol and substance use measures assessed for baseline, pre- and post-lockdown periods.

	Cannabis users (n = 120)						*Controls (n = 63)*					
			Follow-up						*Follow-up*			
	Baseline		*Pre-lockdown*		*Post-lockdown*		*Baseline*		*Pre-lockdown*		*Post-lockdown*	
	n	*Mean (SD, range)*	*n*	*Mean (SD, range)*	*n*	*Mean (SD, range)*	*n*	*Mean (SD, range)*	*n*	*Mean (SD, range)*	*n*	*Mean (SD, range)*
Substance use												
DSM-5 CUD symptoms	96	4.4 (2.9, 0–11)	104	4.6 (3.0, 0–10)	104	4.3 (3.0, 0–11)	–		–		3	0.0 (0.0, 0–0)
Cannabis use, days/month	96	22.2 (9.4, 0–30)	109	20.8 (10.7,0–31)	109	22.0 (10.5, 0–31)†	–		–		9	6.4 (4.6, 2–15)
Cannabis use, g/month	–		109	17.2 (18.4, 0–94.5)	109	**21.53 (20.8, 0–105.4)**†††	–		–		9	3.4 (1.8, 1.5–7.5)
Illicit substance use, *n*/month	120	3.0 (2.8, 0–11)	120	0.8 (1.5, 0–8.3)	120	1.0 (3.8, 0–31.9)	63	**1.3 (1.9, 0–9)*****	63	0.3 (0.6, 0–3.6)**	63	0.5 (1.8, 0–13.5)
Cigarette use per day	53	7.4 (5.1, 0–22)	63	8.7 (6.5, 0–25)	64	8.4 (7.3, 0–30)	6	7.8 (4.7, 2–15)	10	8.5 (4.2, 4–18)	8	9.9 (8.2, 0–24)
Alcohol use, drinks/month	–		111	28.1 (36.4, 0–202)	111	28.9 (46.4, 0–264)	–		58	26.2 (25.8, 0–118)	58	28.7 (46.6, 0–264)
AUDIT, past year	96	6.8 (3.9, 0–18)	–	–	115	7.9 (5.7, 0–31)	57	7.1 (4.9, 0–24)	–		61	7.0 (5.0, 0–22)

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders; CUD = cannabis use disorder; AUDIT = Alcohol Use Disorder Identification Test; SD = standard deviation; group differences $^{**}P < 0.01$ $^{***}P < 0.001$ within-group effects of time = $^{\dagger}P < 0.05$ $^{\dagger\dagger\dagger}P < 0.001$ Bold type refers to significant results with at least moderate Bayesian evidence support.

Table 2 Overview all measures assessed at follow-up for pre- and post-lockdown periods and for pre- to post-lockdown change.

	Cannabis users (n = 120)						*Controls (n = 63)*					
	Pre-lockdown			*Post-lockdown*			*Pre-lockdown*			*Post-lockdown*		
	Mean	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*
Motives for cannabis use												
Enhancement	16.4	4.1	0–23	16.6	4.4	5–25	–	–	–	–	–	–
Coping	10.6	4.7	0–23	11.6†	5.4	5–25	–	–	–	–	–	–
Expansion	11.1	6.3	0–25	10.9	6.4	5–25	–	–	–	–	–	–
Social	12.7	5.6	0–25	**10.5**†††	5.4	5–25	–	–	–	–	–	–
Mental health (DSM-5-CCSM)												
Total	18.1	11.9	0–55	17.9	13.4	0–68	**11.1*****	7.8	0–49	**11.8****	8.8	0–56
Depression	2.7	1.8	0–8	2.9	2.1	0–8	**1.9*****	1.3	0–8	2.1**	1.5	0–6
Anxiety	3.0	2.6	0–12	2.9	3.0	0–12	4.2	1.9	0–9	2.5	2.2	0–12
Sleep problems	1.3	1.2	0–4	1.4	1.3	0–4	0.7**	0.8	0–3	0.9*	1.0	0–4
COVID-19-related worries												
Personal health	–	–	–	2.2	1.0	1.0–5.0	–	–	–	1.9	0.9	1.0–5.0
Personal economics	–	–	–	2.2	1.3	1.0–5.0	–	–	–	2.0	1.1	1.0–5.0
Contamination	–	–	–	2.6	0.8	1.0–4.7	–	–	–	2.5	0.8	1.0–4.3
Societal functioning	–	–	–	2.6	0.8	1.0–4.8	–	–	–	2.6	0.8	1.0–4.3
Employment												
Weekly working hours	16.6	15.0	0–50	9.5	14.0	0–50	16.4	13.6	0–46	8.7	12.7	0–52
Job loss	–	–	–	30%			–	–	–	34%		

	Pre- to post-lockdown change			*Pre- to post-lockdown change*		
	Mean	*SD*	*Range*	*Mean*	*SD*	*Range*
Social contact						
Loneliness	**3.6**†††	0.9	1–5	**3.5**†††	0.8	2–5
In-person, partner	3.1	0.9	1–5	3.2	0.9	1–5
In-person, family	**2.6**†††	1.1	1–5	2.6†	1.2	1–5
In-person, friends	**1.8**†††	0.9	1–5	**1.5**$^{\dagger\dagger\dagger\ **}$	0.7	1–5
On-line, partner	3.0	0.9	1–5	3.1	0.9	1–5
On-line, family	**3.3**†††	0.8	1–5	3.2†	0.7	1–5
On-line, friends	**3.7**†††	1.0	1–5	**4.0**†††	0.9	1–5
Quality, partner	**3.2**††	0.7	1–5	3.2†	0.7	1–5
Quality, family	**3.2**†††	0.5	2–5	3.1†	0.5	1–4.5
Quality, friends	2.8†	0.9	1–5	2.9	0.8	1–5

Group differences $^{*}P < 0.05$ $^{**}P < 0.01$ $^{***}P < 0.001$ within-group effects of time $^{\dagger}P < 0.05$ $^{\dagger\dagger}P < 0.01$ $^{\dagger\dagger\dagger}P < 0.001$ Bold type refers to significant results with at least moderate Bayesian evidence support.

lockdown (Cronbach's α = 0.83) in monthly users, with scores ranging from 0 to 11. At baseline, cannabis use was assessed in days per week for screening purposes. Days per week were multiplied by 4.3 to compute days per month. At follow-up, cannabis use was assessed in days per month during the pre- and post-lockdown periods. Cannabis use in grams per month was assessed during the pre- and post-lockdown periods for descriptive purposes.

Other substance use

Alcohol use and related problems were assessed with the 10-item Alcohol Use Disorder Identification Test (AUDIT [22]) at baseline (Cronbach's α = 0.73) and at follow-up (Cronbach's α = 0.80), both assessments referring to the past year. AUDIT item scores ranged from 0 to 4 and AUDIT total scores were computed by summing item scores. Alcohol use in drinks per month was assessed at follow-up during the pre- and post-lockdown periods. Cigarette use (yes/no), number of cigarettes per day and frequency of past month illicit substance use were assessed during the baseline, pre- and post-lockdown periods.

Motives for cannabis use

Motives for use in the year preceding lockdown and the period since lockdown were assessed with the five-item coping

(i.e. to reduce negative affect, Cronbach's α pre-lockdown = 0.81, post-lockdown = 0.88), five-item social (i.e. to enhance social events, Cronbach's α pre-lockdown = 0.89, post-lockdown = 0.90), five-item enhancement (i.e. to enhance positive affect, Cronbach's α pre-lockdown = 0.74, post-lockdown = 0.81) and five-item expansion (i.e. expand thoughts and experiences, Cronbach's α pre-lockdown = 0.96, post-lockdown = 0.96) subscales from the marijuana motives measure (MMM [23]). Each scale contained five questions scored on a five-point Likert scale from 'almost never' (1) to 'almost always' (5). Scale scores were computed by summing item scores.

Mental health

The DSM-5 self-rated level 1 cross-cutting symptom measure—adult (DSM-5-CCSM [24]) was administered at follow-up to assess general mental health during the pre- and post-lockdown periods. Substance use items were excluded, and assessment time was changed to reflect the year preceding lockdown and the period since lockdown. Each item was scored on a five-point Likert scale from 'never' (0) to 'always' (4). Given the high comorbidity with CUD [10], we included the total (20 items; Cronbach's α pre-lockdown = 0.91, post-lockdown = 0.92), depression (two items; Cronbach's α pre-lockdown = 0.80, post-lockdown = 0.80), anxiety (4-items; Cronbach's α pre-lockdown = 0.78, post-lockdown = 0.82) and sleep problems (1-item) scores in further analysis.

COVID-19-related worries

Worries about personal health consequences (two items; Cronbach's α = 0.59), personal economic consequences (two items; Cronbach's α = 0.80), contamination (two items; Cronbach's α = 0.72) and societal consequences (four items; Cronbach's α = 0.71) were assessed with a self-developed questionnaire (see Supporting information, Table S1). Each item was scored on a five-point Likert scale from 'no worries' (1) to 'many worries' (5). Each worry score reflects the average of the item scores (Cronbach's α = 0.59–0.80).

Social contact

Pre- to post-lockdown change in frequency of on-line and in-person contact with partners, family and friends was assessed with five-point Likert scales from 'a lot less' (1) to 'a lot more' (5). Pre- to post-lockdown change in the quality of contact with partners, family and friends were assessed with five-point Likert scales from 'much worse' (1) to 'much better' (5). Change in loneliness pre- to post-lockdown was assessed with a single item, scored on a five-point Likert scale from 'a lot less' (1) to 'a lot more' (5).

Statistical analysis

Main analyses in cannabis users

To investigate (i) if lockdown was associated with change in cannabis use (days per month) and CUD symptom severity, two separate linear mixed-model analyses were conducted. Participants with at least two assessments for cannabis use (three time-points: n = 96, two time-points: n = 24) or CUD (three time-points: n = 81, two time-points: n = 26) were included (missing data resulted from no to minimal cannabis use at either baseline or pre-lockdown). The effects of time [continuous variable with three data-points; baseline (minus days before lockdown), pre-lockdown (12 March 2020 = 0) and post-lockdown (plus days since lockdown)] on both outcomes were assessed using maximum likelihood estimation and a random intercept, with subject and time as random variables to account for repeated measures. Lockdown status (0 at baseline, 0 at pre-lockdown, 1 at post-lockdown) was subsequently added to the model to assess the additional effect of lockdown, followed by the interaction between time and lockdown status. To assess (a) individual differences in effects of time and lockdown status, (b) potential effects of differences in time between measures and (c) potential non-linear time effects, we assessed model fit after allowing for variable slopes (random slope model), adding a continuous autocorrelation structure of order 1 (with participant as the grouping factor) and assessing quadratic and cubic effects of time, respectively. Model fit was assessed using Akaike's information criterion (AIC) and Bayes information criterion (BIC) values of model comparison.

Next, we (ii) exploratively investigated if pre- to post-lockdown change in cannabis use and CUD symptom severity related to change in cannabis use motives, mental wellbeing, social contact and job status. This was performed in multiple steps, first assessing pre- to post-change in cannabis use motives, mental wellbeing and quality of social relationships. Given the non-normal data distributions, non-parametric repeated-measures Friedman tests and Wilcoxon signed-rank tests were used. Next, pre- to post-lockdown change scores were computed (pre- minus post-lockdown, reflecting change between lockdown period and the period just before lockdown onset) for these variables, and non-parametric Kendall's tau-b correlations were computed to assess if change correlated with pre- to post-lockdown change in cannabis use and CUD symptom severity. Moreover, non-parametric Kruskal–Wallis tests as part of analyses of covariance (ANCOVAs) were run to investigate if pre- to post-lockdown change in CUD symptoms and use (corrected for baseline CUD symptoms and use, respectively) differed between cannabis users who did or did not lose their job. Finally, two

explorative regression models with feed-forward model selection (bootstrap = 5000, to account for assumption violations) were run to assess which variable(s) uniquely explained change in CUD symptoms and cannabis use, entering both pre-lockdown and change scores in mental wellbeing, marijuana motives, quality of social relationships and job status.

Comparison between cannabis users and controls

For reference and descriptive purposes, (iii) group differences in sample characteristics (including alcohol, cigarette and illicit substance use) and changes in mental wellbeing, quality of social relationships and job status were assessed. Group differences in pre- to post-change scores, i.e. loneliness, alcohol use (AUDIT and drinks per months), illicit substance use and DSM-5-CCSM total and subscores were assessed with ANCOVAs [25], correcting for pre-lockdown scores and gender. Given the non-normal data distributions, non-parametric repeated-measures Friedman and Mann–Whitney *U*-tests were used. Group differences in repeated measures assessed at follow-up, i.e. COVID-19-related worries and change in social contact, were assessed using linear mixed models with maximum likelihood estimation, random intercept and the within-subject variable as a random effect to account for repeated measures.

Bayesian analyses

Given the novelty of the topic, the explorative nature of this study and to allow for novel hypothesis formation, we decided not to correct for multiple comparisons. Instead, complementary Bayesian analyses were conducted and interpretation of the evidence strength followed Jeffreys' benchmarks [26]: anecdotal (i.e. not enough evidence to support or refute H0) = Bayes factor (BF) = 1–3, moderate = BF 3–10, strong = BF 10–30, very strong = BF 30–100 and extremely strong = BF > 100. Analyses were run in JASP (JASP team, 2019) and R version 4.0.2. We considered an effect significant if both $P < 0.05$ and BF > 3. Analyses were not pre-registered.

RESULTS

Pre- to post-lockdown change in cannabis users

Cannabis use and CUD symptom severity

While time had a small but significant negative effect on cannabis use (Table 3; $B = -0.01$, 95% CI = −0.01 to –0.00, $P = 0.022$), lockdown was associated with an increase in cannabis use ($B = 1.96$, 95% CI = 0.26–3.66, $P = 0.024$). Similarly, comparing pre- to post-lockdown cannabis use in grams per week, there was very strong evidence for an increase in use ($W = 1488.5$, $P < 0.001$, $BF_{10} = 62.5$; see Table 1). For CUD symptom severity, there was a small but significant interaction between time and lockdown status ($B = -0.04$, 95% CI = −0.08 to −0.01, $P = 0.025$), indicative of a difference in the effect of time on CUD symptom severity during and before lockdown. *Post-hoc* regression analyses showed no associations between total assessment time (days between baseline and follow-up) and baseline to post-lockdown change in CUD

Table 3 Overview of final models to assess change in cannabis use (days per month) and CUD symptom severity as a function of time and lockdown status.

	Model coefficients						
	Fixed effects					*Random effects*	
Model *Cannabis use in days per month*	*B*	*95% CI (B)*	*SE (B)*	*t*	*P*	*SD*	*95% CI*
(intercept)	19.26	17.30 to 21.22	1.00	19.25	< 0.001	9.16	7.91–10.65
Time	−0.01	–0.01 to –0.00	0.00	2.30	0.022	–	–
Lockdown status	1.96	0.26 to 3.66	0.87	2.26	0.024	–	–
	Fixed effects					*Random effects*	
DSM-5 CUD symptom severity	*B*	*95% CI (B)*	*SE (B)*	*t*	*P*	*SD*	*95% CI*
(intercept)	4.61	4.06 to 5.17	0.28	16.30	< 0.001	2.67	2.31–3.09
Time	0.00	–0.00 to 0.00	0.00	0.20	0.839	0.01	0.00–0.01
Lockdown status	2.30	0.04 to 4.55	1.15	2.00	0.047	–	–
Time × lockdown status	−0.04	−0.08 to −0.01	0.02	2.26	0.025	–	–

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders; SD = standard deviation; CI = confidence interval; CUD = cannabis use disorder; note: models assessing the effect of a continuous autocorrelation structure of order 1, quadratic effects of time and cubic effects of time did not improve model fit. An overview of the model selection can be found in Supporting information, Table S2.

($B = -0.00$, $t_{(79)} = -0.75.34$, $P = 0.457$) or between time (days between baseline and lockdown onset) and change in CUD before lockdown ($B = -0.00$, $t_{(79)} = 0.34$, $P = 0.729$). There was a small negative association between time and change in CUD score during lockdown ($B = -0.05$, $t_{(105)} = 2.40$, $P = 0.018$). There was no evidence for a pre- to post-lockdown change in CUD symptoms ($W = 1509.5$, $P = 0.66$, $BF_{10} = 0.57$).

Marijuana use motives

Enhancement motives were most prevalent (Fig. 1). A Friedman test assessing differences in change in coping, enhancement, social and expansion motives was significant ($\chi^2_{(3)} = 37.36$, $P < 0.001$). *Post-hoc* tests indicated moderate evidence for no change in enhancement ($W = 1289.00$, $P = 0.732$, $BF_{10} = 0.110$) and expansion motives ($W = 1016.50$, $P = 0.452$, $BF_{10} = 0.193$), but extremely strong evidence for a decrease in social motives ($W = 3077.00$, $P < 0.001$, $BF_{10} > 100$) and anecdotal evidence for an increase in coping motives ($W = 645.50$, $P = 0.003$, $BF_{10} = 2.84$).

Mental wellbeing

DSM-5-CCSM total, depression, anxiety and sleep problem scores did not change (all $Ps > 0.277$, all $BF_{10} < 0.139$). COVID-19-related worries about personal health, personal economic consequences, contamination and societal functioning significantly differed from each other ($\chi^2_{(3)} = 35.59$, $P < 0.001$). *Post-hoc* tests indicated equal worries about contamination and societal consequences ($W = 3380.00$, $P = 0.649$, $BF_{10} = 0.102$) that were higher than worries about personal health (contamination–personal health: $W = 4741.00$, $P < 0.001$, $BF_{10} > 100$; societal consequences–personal health: $W = 1050.00$, $P < 0.001$, $BF_{10} > 100$) and economic consequences (contamination–economic consequences: $W = 4707.00$, $P < 0.001$, $BF_{10} = 25.62$; societal–economic consequences: $W = 1791.50$, $P < 0.001$, $BF_{10} > 100$). Participants were equally worried about personal health and economic consequences ($W = 2293.00$, $P = 0.899$, $BF_{10} = 0.101$).

Social contact

Evidence was extremely strong for an increase in loneliness ($W = 2690.00$, $P < 0.001$, $BF_{10} > 100$, see Table 2). Regarding pre- to post-lockdown change in social contact (Fig. 1, Table 2), change in on-line ($\chi^2_{(2)} = 37.09$, $P < 0.001$), in-person ($\chi^2_{(2)} = 73.48$, $P < 0.001$) and quality of ($\chi^2_{(2)} = 22.51$, $P < 0.001$) contact differed between partner, family and friends. *Post-hoc* tests indicated that partner contact in-person ($W = 588.00$, $P = 0.265$,

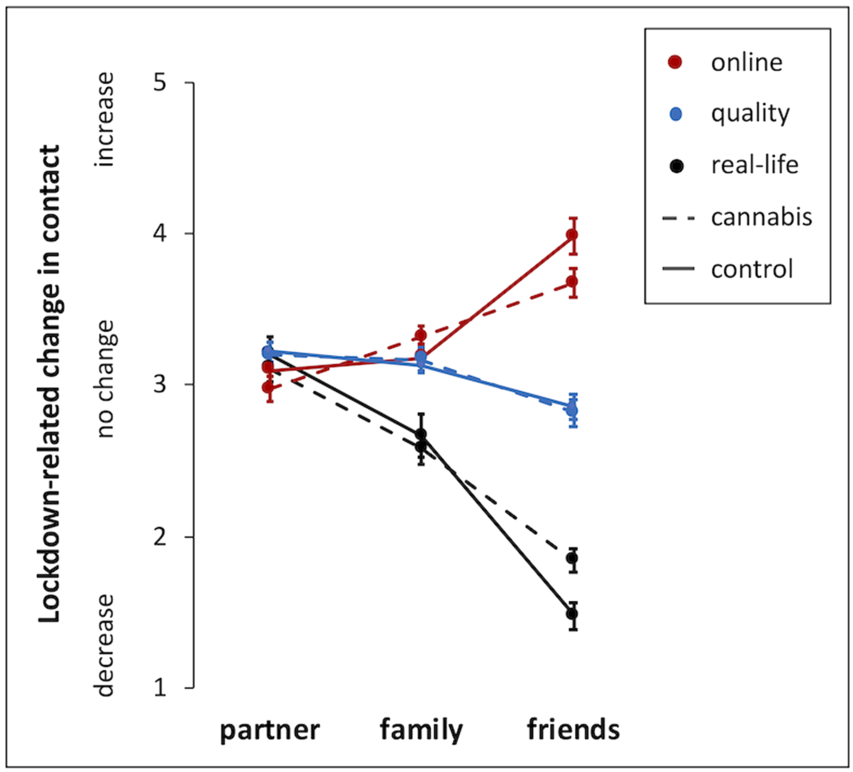

Figure 1 COVID-19 lockdown-related change in in-person, on-line and quality of contact with partners, family and friends (3 = no change). Means and standard error are reported. A decrease in in-person contact paralleled an increase in on-line contact with family and friends. Quality increased for partners and family and decreased for friends. Compared to cannabis users, controls showed a larger reduction in in-person contact with friends. [Colour figure can be viewed at wileyonlinelibrary.com]

BF_{10} = 0.219) and on-line (W = 344.00, P = 0.675, BF_{10} = 0.106) did not change (test-value = 3), but relative to partners, family contact was reduced in-person (W = 2843.00, $P < 0.001$, $BF_{10} > 100$) and increased on-line (W = 918.50, P = 0.002, BF_{10} = 15.12). Relative to family, friend contact was reduced in-person (W = 3445.00, $P < 0.001$, $BF_{10} > 100$) and increased on-line (W = 1086.50, P = 0.002, BF_{10} = 20.99). Regarding contact quality, there was moderate evidence for improved contact with partners (W = 578.00, P = 0.005, BF_{10} = 8.21) and strong evidence for improved contact with family (W = 1006.00, $P < 0.001$, BF_{10} = 19.73). Evidence was only anecdotal for decreased contact quality with friends (W = 919.00, P = 0.023, BF_{10} = 1.38).

Pre- to post-lockdown change in cannabis use and CUD symptom severity; associations with change in use motives, mental wellbeing, social contact and job status

The current data provide strong evidence for a small positive correlation between change in CUD symptoms and change in enhancement motives and worries about COVID-19 contamination (Table 4). Change in CUD symptoms also correlated weakly positively with DSM-5-CCSM total, anxiety and sleep problems, but with moderate-evidence strength. Regarding cannabis use, there was moderate evidence for a weak positive correlation with change in enhancement motives only. Pre- to post-change in CUD symptoms ($\chi^2_{(1)}$ = 0.88, P = 0.348) and use ($\chi^2_{(1)}$ = 3.22, P = 0.073) did not differ between cannabis users who did and did not lose their job.

The regression analysis to explore which variables uniquely explained change in CUD symptoms revealed extremely strong evidence that lower pre-lockdown CUD symptoms, lower worries about personal economic consequences and higher worries about personal health related to increases in CUD symptoms, each significantly explaining unique variance in change (see Table 4). Moreover, larger increases in both anxiety and the quality of family relationships related to increases in CUD symptoms, but with moderate-evidence strength. Change in coping motives was a non-significant predictor in the final model.

The regression analysis to explore which variables uniquely explained change in cannabis use revealed very strong evidence that lower pre-lockdown cannabis use and higher expansion motives related to higher increases in cannabis use, each significantly explaining unique variance in change. Moreover, change in CUD symptoms and social motives also related to increased cannabis use, but with moderate-evidence strength. Change in loneliness was a significant predictor in the final model, but with anecdotal-evidence strength.

Table 4 Relations between change cannabis use and change in use motives, mental wellbeing and quality of social relationships.

		Self-reported change pre- to post-COVID-19 lockdown			
		DSM-5 CUD symptoms		*Cannabis use, days month*	
		Kendall's tau	*BF_{10}*	*Kendall's tau*	*BF_{10}*
Self-reported change pre- to post-COVID-19 lockdown	Cannabis use, days/month	0.13	0.94		
	Social motives	−0.05	0.17	0.14	1.13
	Enhancement motives	**0.23****	**45.85**	**0.19***	**7.32**
	Coping motives	0.08	0.28	0.15*	1.71
	Expansion motives	0.04	0.15	0.16*	2.44
	DSM-5-CCSM total	**0.19****	**6.90**	−0.03	0.14
	DSM-5-CCSM depression	0.16*	2.47	0.07	0.20
	DSM-5-CCSM anxiety	**0.18***	**4.90**	−0.09	0.33
	DSM-5-CCSM sleep problems	**0.18***	**5.91**	0.12	0.73
	Pre–post change loneliness	0.12	0.69	0.15	1.71
	Contact quality partner	−0.06	0.18	−0.03	0.14
	Contact quality family	0.12	0.68	−0.04	0.15
	Contact quality friends	−0.06	0.20	0.06	0.20
	COVID-19-related worries				
	Personal health	−0.00	0.13	0.04	0.15
	Personal economics	−0.11	0.56	0.03	0.14
	Contamination	**0.21****	**20.86**	0.109	0.51
	Societal functioning	−0.00	0.13	−0.03	0.14

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders; CUD = cannabis use disorder; motives were measured with the marijuana motives measure; CCSM = cross-cutting symptom measure $^{*}P < 0.05$ $^{**}P < 0.01$ BF_{10}: Bayes factor likelihood H1 relative to H01 with default priors. Bold-type correlations and Bayes factors refer to significant results with at least moderate Bayesian evidence support.

Table 5 Predictors of change in cannabis use: feed-forward model selection.

	B	*95% CI bca (B)*	*SE (B)*	*B*	*t*	*P*	BF_{10}
Pre- to post-COVID 19 lockdown change DSM-5 CUD symptoms: final model $F_{(6,96)} = 11.33$, adjusted $R^2 = 0.48$, $P < 0.001$							
DSM-5 CUD, pre-lockdown	**–0.20**	**–0.30 to –0.09**	**0.05**	**–0.32**	**4.00**	**< 0.001**	**> 100**
Coping motives, change	0.09	–0.03 to 0.22	0.06	0.17	1.81	0.074	1.18
DSM-5-CCSM anxiety, change	**0.21**	**0.04 to 0.38**	**0.08**	**0.25**	**2.65**	**0.009**	**6.16**
Change contact quality family	**0.72**	**0.19 to 1.27**	**0.28**	**0.20**	**2.46**	**0.016**	**4.07**
COVID-19-related worries, personal economic	**–0.49**	**–0.80 to –0.23**	**0.14**	**–0.35**	**3.79**	**< 0.001**	**> 100**
COVID-19-related worries, personal health	**0.77**	**0.38 to 1.19**	**0.21**	**0.39**	**4.08**	**< 0.001**	**> 100**
Pre- to post-COVID 19 lockdown change cannabis use (days per month): final model $F_{(5,97)} = 14.37$, adjusted $R^2 = 0.40$, $P < 0.001$							
Cannabis use, days months, pre-lockdown	**–0.31**	**–0.45 to –0.18**	**0.07**	**–0.38**	**4.80**	**< 0.001**	**> 100**
DSM-5 CUD, change	**0.93**	**0.23 to 1.81**	**0.39**	**0.21**	**2.67**	**0.009**	**6.03**
Expansion motives, change	**0.83**	**0.32 to 1.33**	**0.25**	**0.29**	**3.67**	**< 0.001**	**88.90**
Social motives, change	**0.35**	**0.03 to 0.66**	**0.16**	**0.21**	**2.61**	**0.011**	**5.20**
Loneliness, change	1.47	0.15 to 2.80	0.67	0.17	2.18	0.031	2.11

DSM-5 = Diagnostic and Statistical Manual of Mental Disorders; CUD = cannabis use disorder; motives were measured with the marijuana motives measure; CCSM: cross-cutting symptom measure; CI bca = confidence interval bias-corrected accelerated; SE = standard error); 95% CI based on bootstrapping 5000 replications. BS_{10}: Bayes factor likelihood H1 relative to H01 with default priors of including all other measures to the null model. Bold-type regression results refer to significant effects with at least moderate Bayesian evidence support.

Control analyses adding alcohol, illicit substance use and cigarette use revealed similar results (note: power was low due to missing data of non-users).

Cannabis users versus controls

Age ($W = 3129.00$, $P = 0.11$, $BF_{10} = 0.36$) did not differ between groups, but there were more women (cannabis users = 43%; controls = 75%; $\chi^2_{(2)} = 17.8$, $P < 0.001$, $BF_{10} > 100$), more students (cannabis users = 55%; controls = 73%; $\chi^2_{(1)} = 5.6$, $P = 0.017$, $BF_{10} = 3.0$) and fewer cigarette smokers (cannabis users = 55%, controls = 10% at baseline; $\chi^2_{(1)} = 23.8$, $P = 0.001$, $BF_{10} > 100$) in the control group. Alcohol use did not change and did not differ between groups (see Table 1). Illicit substance use also did not change, but there was strong evidence for higher baseline ($W = 5091.0$, $P < 0.001$, $BF_{10} = 16.1$) and anecdotal evidence for higher pre-lockdown ($W = 4742.5$, $P = 0.003$, $BF_{10} = 2.01$) use in cannabis users.

Regarding mental wellbeing, cannabis users scored significantly higher on DSM-5-CCSM total, depression and sleep problems (Table 2); however, Bayesian evidence only supported a group difference on pre-lockdown DSM-5-CCSM total ($W = 5287.5$, $P < 0.001$, $BF_{10} = 62.9$) and depression ($W = 5287.5$, $P < 0.001$, $BF_{10} = 62.9$) scores. COVID-19-related worries did not differ between groups ($Ps > 0.06$, $BF_{10} < 0.54$). As in cannabis users, only loneliness significantly increased pre- to post-lockdown in the control group ($W = 846.50$, $P < 0.001$, $BF_{10} > 100$), but change in loneliness did not differ between groups.

The percentage of individuals who lost their job during the COVID-19 lockdown did not differ between groups ($\chi^2_{(1)} = 0.4$, $P = 0.51$, $BF_{10} = 0.23$).

Pre- to post-lockdown change in social contact was similar between cannabis users and controls (no main or interaction effects with group, Fig. 1), except for frequency of in-person contact (group interaction; $\chi^2_{(2)} = 6.31$, $P = 0.04$). *Post-hoc* analysis showed that in-person contact with friends, but not partners of family, was more reduced in controls ($W = 4690.50$, $P = 0.003$, $BF_{10} = 5.98$), with moderate-evidence strength.

DISCUSSION

The COVID-19 pandemic and lockdown measures substantially impact daily life, highlighting the importance of monitoring the wellbeing of vulnerable populations, including cannabis users. The cannabis users included in this explorative study used, on average, 4–5 days per week, and 57% had a moderate to severe CUD before lockdown. Our longitudinal survey data showed a significant increase in cannabis use during the first months of lockdown. There was no evidence for a change in CUD symptom severity, but during lockdown time was weakly associated with reductions in CUD. The increase in use related to an increase in motives to use cannabis for expansion of thoughts and experiences. Moreover, while feelings of loneliness generally increased, both cannabis users and controls reported improved contact with partners and family and no change in symptoms of depression, anxiety or sleep problems, despite ~30% losing their job. These results suggest a minimal impact of the lockdown on mental wellbeing in cannabis users. However, there were substantial individual differences that need to be taken into account, and increased anxiety and worries concerning the impact of

COVID-19 on personal health related to increased CUD symptoms.

Which cannabis users are at risk for increasing cannabis use and CUD severity is an important question. We expected lockdown-related decreases in social relationships [19,20], job loss [7,8] and increases in mental health problems to relate to increases in cannabis use and CUD symptoms. Our results reflect changes during the first 2 months after lockdown, and the explorative and partly retrospective nature of this study prevents us from drawing conclusions about causality. Nevertheless, as expected, changes in mental wellbeing covaried with changes in CUD symptom severity, with anxiety explaining unique variance with moderate-evidence strength. This relationship is probably bidirectional, with anxiety being both a risk factor for and a consequence of CUD [27]. Unexpectedly, job loss did not affect CUD severity or cannabis use and better contact with family predicted an increase in CUD severity. It could be that worries expressed by family members and the feeling of positive family support increased awareness and reporting of the severity of their cannabis use [28], warranting a more long-term and in-depth assessment of lockdown impact on cannabis users' wellbeing.

The strongest evidence was observed between change in CUD symptom severity and COVID-19-specific worries. Interestingly, in a small US sample, Rogers *et al.* [29] showed that individuals who initiated cannabis use during the pandemic had higher COVID-19-related worries than non-users and pre-pandemic users, supporting the inclusion of COVID-19-related worries in future studies. We observed strong evidence for a positive correlation between contamination worries and change in CUD severity. However, we also observed extremely strong evidence for lower worries regarding personal economic consequences and higher worries regarding personal health uniquely predicting increasing CUD severity (as well as baseline CUD severity, change in anxiety and quality of family contact). In both cannabis users and controls, these worries were lower than worries about contamination and societal consequences. The relatively low worries regarding personal economic consequences, but also the 55% student sample (with perhaps other means of financial support), might explain the lack of an effect of job loss on cannabis use. The link between worry about mental and physical health and increased reported CUD severity may be indicative of self-awareness of cannabis use severity. Compromised self-awareness has been linked to poor addiction prognosis [30], highlighting the need to investigate the impact of the lockdown in more severe clinical populations with CUD.

Regarding cannabis use motives, we observed a reduction in social motives that uniquely explained variance in change of cannabis use, such that a larger reduction in social motives was related to a larger reduction in cannabis use frequency. This intuitively follows the implemented social distancing measures and the significant decrease in in-person contact with friends. We also expected increased in coping motives [14], but our data provide insufficient evidence to support or refute associations with change in cannabis use and CUD symptom severity. In contrast, evidence was very strong for increasing expansion motives predicting increasing use, suggestive of use as a result of lockdown induced boredom and the need for a 'mental breakout'. As in previous studies, expansion motives correlated with use, but endorsement is generally low compared to enhancement motives [31,32].

Our longitudinal data on cannabis use and CUD severity, including assessments prior to and during the first months of the Dutch lockdown, is a clear strength. The negative association between time and change in CUD symptom severity during the lockdown (but no main effect of lockdown) may suggest less change in severity the further away from lockdown onset, or even a potential reduction. This highlights the need for studies that assess the long-term impact of the pandemic in vulnerable populations. Importantly, while cannabis outlets remained open in the Netherlands, the lockdown may have significantly impacted the cannabis market in other countries [33]. It is therefore recommended that future studies take potentially restricted access and other cultural factors into account. Moreover, given the impact of the lockdown on social and work life, and the fact that severity of CUD is, in part, measured by the negative impact of cannabis use on social functioning, the lockdown may fundamentally affect CUD pathology. That is, social distancing and work from home may change CUD symptoms in a way not captured by the MINI version 7.0.0 DSM-5 CUD section, warranting future qualitative and quantitative investigations of lockdown-related changes in CUD pathology and its underlying mechanisms.

Some limitations should be considered. Although the internal consistency of our measures was generally good, the restricted time-frame of the post-lockdown assessment (i.e. self-reported changes during a period of 2 months) and on-line nature of this study may have impacted the validity of our assessments. Moreover, the on-line nature of this study may have introduced a sampling bias, missing the most problematic users [34], and a larger, matched reference group is needed for more finely grained investigations between cannabis users and controls. While in-person research is currently very limited, research via a video connection may be an option, taking issues with poor non-verbal communication, access and privacy into account [35].

In conclusion, our study provides important first insights into psychosocial consequences of the COVID-19 lockdown on cannabis users. Generally, the lockdown

was related to increased cannabis use in cannabis users and increased loneliness and 30% job loss in both cannabis users and control, but the impact on CUD severity and mental health problems seemed minimal and quality of contact with partners and family improved. Pre-lockdown severity of cannabis use, COVID-19-related worries and increases in anxiety, expansion motives, social motives and quality of family contact all uniquely related to increases in cannabis use or CUD. These findings highlight the importance of studying individual differences and long-term effects of the lockdown.

Declaration of interests

None.

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Author contributions

Janna Cousijn: Conceptualization; formal analysis; funding acquisition; methodology. **Lauren Kuhns:** Conceptualization; data curation; formal analysis; methodology. **Helle Larsen:** Formal analysis; methodology. **Emese Kroon:** Conceptualization; data curation; formal analysis; methodology.

References

1. Dubey M. J., Ghosh R., Chatterjee S., Biswas P., Chatterjee S., Dubey S. COVID-19 and addiction. *Diabetes Metab Syndr Clin Res Rev* 2020; **14**: 817–23.
2. Marsden J., Darke S., Hall W., Hickman M., Holmes J., Humphreys K., *et al*. Mitigating and learning from the impact of COVID-19 infection on addictive disorders. *Addiction* 2020; **115**: 1007–10.
3. Lee S. A. Coronavirus anxiety scale: a brief mental health screener for COVID-19 related anxiety. *Death Stud* 2020; **44**: 393–401.
4. Statistics Netherlands (CBS). Economic impact of Covid-19 2020 [cited 2020 Jul 6]. Available at: https://www.cbs.nl/en-gb/dossier/coronavirus-crisis-cbs-figures/economic-impact-of-covid-19 (accessed 6 July 2020).
5. Rajkumar R. P. COVID-19 and mental health: a review of the existing literature. *Asian J Psychiatr* 2020; **52**: 102066.
6. Dom G., Samochowiec J., Evans-Lacko S., Wahlbeck K., Van Hal G., McDaid D. The impact of the 2008 economic crisis on substance use patterns in the countries of the European Union. *Int J Environ Res Public Health* 2016; **13**: 122.
7. Poulton R. G., Brooke M., Moffitt T. E., Stanton W. R., Silva P. A. Prevalence and correlates of cannabis use and dependence in young New Zealanders. *NZ Med J* 1997; **110**: 68–70.
8. Henkel D. Unemployment and substance use: a review of the literature (1990–2010). *Curr Drug Abuse Rev* 2011; **4**: 4–27.
9. Agosti V., Nunes E., Levin F. Rates of psychiatric comorbidity among U.S. residents with lifetime cannabis dependence. *Am J Drug Alcohol Abuse* 2002; **28**: 643–52.
10. Van der Pol P., Liebregts N., De Graaf R., Ten Have M., Korf D. J., Van den Brink W., *et al*. Mental health differences between frequent cannabis users with and without dependence and the general population. *Addiction* 2013; **108**: 1459–69.
11. Briand L. A., Blendy J. A. Molecular and genetic substrates linking stress and addiction. *Brain Res* 2010; **1314**: 219–34.
12. Sinha R. The role of stress in addiction relapse. *Curr Psychiatry Rep* 2007; **9**: 388–95.
13. Hyman S. M., Sinha R. Stress-related factors in cannabis use and misuse: implications for prevention and treatment. *J Subst Abuse Treat* 2009; **36**: 400–13.
14. Benschop A., Liebregts N., van der Pol P., Schaap R., Buisman R., van Laar M., *et al*. Reliability and validity of the marijuana motives measure among young adult frequent cannabis users and associations with cannabis dependence. *Addict Behav* 2015; **40**: 91–5.
15. Vidot D. C., Islam J. Y., Camacho-Rivera M., Harrell M. B., Rao D. R., Chavez J. V., *et al*. The COVID-19 cannabis health study: results from an epidemiologic assessment of adults who use cannabis for medicinal reasons in the United States. *J Addict Dis* 2020; https://doi.org/10.1080/10550887.2020.1811455
16. Rolland B., Haesebaert F., Zante E., Benyamina A., Haesebaert J., Franck N. Global changes and factors of increase in caloric/salty food intake, screen use, and substance use during the early COVID-19 containment phase in the general population in France: survey study. *JMIR Public Heal Surveill* 2020; **6**: e19630.
17. Dumas T. M., Ellis W., Litt D. M. What does adolescent substance use look like during the COVID-19 pandemic? Examining changes in frequency, social contexts, and pandemic-related predictors. *J Adolesc Health* 2020; **67**: 354–61.
18. Vanderbruggen N., Matthys F., Van Laere S., Zeeuws D., Santermans L., Van den Ameele S., *et al*. Self-reported alcohol, tobacco, and cannabis use during COVID-19 lockdown measures: results from a web-based survey. *Eur Addict Res* 2020; **26**: 309–15.
19. Mason M. J., Zaharakis N. M., Rusby J. C., Westling E., Light J. M., Mennis J., *et al*. A longitudinal study predicting adolescent tobacco, alcohol, and cannabis use by behavioral characteristics of close friends. *Psychol Addict Behav* 2017; **31**: 712–20.
20. Boman J. H., Heck C. Friendships and cannabis use. In: *Preedy V., editor. Handbook of Cannabis and Related Pathologies: Biology, Pharmacology, Diagnosis, and Treatment*. Amsterdam, the Netherlands: Elsevier Inc; 2017, pp. 188–97.
21. Sheehan D. V., Lecrubier Y., Sheehan K. H., Amorim P., Janavs J., Weiller E., *et al*. The Mini-international neuropsychiatric interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry* 199822–33.
22. Saunders J. B., Aasland O. G., Babor T. F., de la Fuente J. R., Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption--II. *Addiction* 1993; **88**: 791–804.

23. Simons J., Correia C. J., Carey K. B., Borsari B. E. Validating a five-factor marijuana motives measure: relations with use, problems, and alcohol motives. *J Couns Psychol* 1998; **45**: 265–73.
24. American Psychiatric Association *DSM-5 self-rated level 1 cross-cutting symptom measure–adult*. Arlington, VA: American Psychiatric Publishing; 2013.
25. Clifton L., Clifton D. A. The correlation between baseline score and post-intervention score, and its implications for statistical analysis. *Trials* 2019; **20**: 43.
26. Jeffreys H. *Theory of Probability, 3rd edn. Oxford, UK: Clarendon Press; 1961.*
27. Richardson T. H. Cannabis use and mental health: a review of recent epidemiological research. *Int J Pharmacol* 2010; **6**: 796–807.
28. Templeton L., Velleman R., Russell C. Psychological interventions with families of alcohol misusers: a systematic review. *Addict Res Theory* 2010; **18**: 616–48.
29. Rogers A. H., Shepherd J. M., Garey L., Zvolensky M. J. Psychological factors associated with substance use initiation during the COVID-19 pandemic. *Psychiatry Res* 2020; **293**: 113407.
30. Moeller S. J., Goldstein R. Z. Impaired self-awareness in human addiction: deficient attribution of personal relevance. *Trends Cogn Sci* 2014; **18**: 635–41.
31. Buckner J. D., Zvolensky M. J., Schmidt N. B. Cannabis-related impairment and social anxiety: the roles of gender and cannabis use motives. *Addict Behav* 2012; **37**: 1294–7.
32. Bonar E. E., Goldstick J. E., Collins R. L., Cranford J. A., Cunningham R. M., Chermack S. T., *et al*. Daily associations between cannabis motives and consumption in emerging adults. *Drug Alcohol Depend* 2017; **178**: 136–42.
33. Groshkova T., Stoian T., Cunningham A., Griffiths P., Singleton N., Sedefov R. Will the current COVID-19 pandemic impact on long-term cannabis buying practices? *J Addict Med* 20206–8.
34. Pierce M., McManus S., Jessop C., John A., Hotopf M., Ford T., *et al*. Says who? The significance of sampling in mental health surveys during COVID-19. *Lancet Psychiatry* 2020; **7**: 567–8.
35. Dodds S., Hess A. C. Adapting research methodology during COVID-19: lessons for transformative service research. *J Serv Manag* 2020; https://doi.org/10.1108/JOSM-05-2020-0153

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1 COVID-19-related worries about personal health, personal economic consequences, contamination, and societal functioning.
Table S2 Overview of model selection to assess change in cannabis use (days per month) and CUD symptom severity as a function of time and lockdown status.
Figure S1 Baseline and follow-up assessment times for each cannabis user and control in months relative to lockdown onset (March 12).

