Changes in cannabis use and associated correlates during France’s first COVID-19 lockdown in daily cannabis users: results from a large community-based online survey

Salim Mezaache1, Cécile Donadille1, Victor Martin2, Maëla Le Brun Gadelius2, Laurent Appel2, Bruno Spire1, Laelia Briand Madrid1, Martin Bastien1 and Perrine Roux1,3*

Abstract

Background: Lockdown measures during the first wave of the COVID-19 pandemic in France led to serious public health concerns over people who use illicit drugs, especially in terms of mental health. We assessed changes in cannabis use during the first lockdown in France among daily cannabis users and associated correlates.

Methods: CANNAVID is a French, national, cross-sectional web-based survey, conducted from 17 April to 11 May 2020. Daily cannabis users aged ≥ 18 years and living in France were invited to participate through advertisements. Respondents completed an ad hoc questionnaire on a dedicated online platform. We analyzed changes in cannabis use during the first lockdown (i.e., stopped, decreased, unchanged, or increased) and performed a multinomial logistic regression analysis to evaluate correlates of these changes.

Results: Of the 4019 participants, 74.0% were men. Median age was 27 years (interquartile range: 22–37). With regard to cannabis use, 293 (7.3%) persons stopped, 1153 (28.7%) decreased, 1146 (28.5%) did not change, and 1427 (35.5%) increased their use during the lockdown. A multinomial logistic regression model revealed several sociodemographic, behavioral and health-related factors associated with changes in cannabis use. Compared with participants with an unchanged level of cannabis use during the lockdown, those who increased and those who stopped cannabis use were more likely to have increased tobacco and alcohol use and to have experienced depression and sleep disorders intensification. Those who stopped cannabis use were also more likely to have increased benzodiazepine use and to have experienced pain increase during lockdown.

Conclusions: France’s first COVID-19-related lockdown had a differential impact on daily cannabis users’ consumption patterns. Most study respondents reported changes to their cannabis consumption pattern. Those who reported a stable cannabis use were more likely to report fewer negative changes. Specific interventions are needed for this population, as well as research to assess the long-term impacts of these changes.

Keywords: Cannabis, COVID-19, Quarantine, Mental health, Pain, Sleep disorders

Introduction

The health emergency caused by the coronavirus disease 2019 (COVID-19) pandemic prompted the French government to implement lockdown measures to control its spread [1]. The country’s first lockdown ran from 17
March to 11 May 2020. Measures included the closure of schools and non-essential retail shops, as well as stay-at-home orders and travel restrictions. People were only allowed to leave their homes for work (through exemptions), essential shopping, health issues, urgent family needs and physical activity. The latter was restricted to one hour per day within a 1 km radius from home [2]. Failure to comply with these rules was sanctioned by a 135€ fine [3]. This lockdown rapidly affected the everyday lives of the French population at the socio-professional, economical, behavioral and psychological levels [4, 5]. Concerns for people in France who use illicit drugs arose following preliminary results from qualitative surveys, drug addiction monitoring system reports and community alerts [6, 7], which highlighted substantial changes in the illicit drug market, specifically the closure of dealers’ points of sale, supply shortages and a surge in prices. These findings reflected those for certain areas in the United States of America, where an immediate decrease in cannabis and methamphetamine seizures was observed during lockdown because of less availability [8]. Worldwide, changes in drug use patterns—both increases and decreases—were reported for different general populations [9–11].

Despite France’s repressive policy on cannabis, it is the most widely consumed illicit drug in the country. In 2017, a national representative survey estimated that almost half of the French population aged between 18 and 64 years old reported lifetime cannabis use while one in ten reported consuming the drug in the previous month [12]. It was also estimated that there are approximately 900,000 daily cannabis users (CU) in France. While a large proportion of CU are recreational users [13], some (also) use the drug for therapeutic purposes. Indeed, despite its association with physical and cognitive risks [14, 15], the therapeutic benefits of cannabis for chronic pain [16], spasticity in multiple sclerosis [17] and chemotherapy-induced nausea and vomiting [18] are widely recognized. These benefits underline why several studies have reported that CU use the drug to relieve physical and psychological symptoms associated with chronic diseases [19], pain [20], insomnia [21], anxiety and depression [22], and loss of appetite [23].

In the context of the ongoing COVID-19 pandemic (as of September 2021), many uncertainties exist over the impact of the pandemic and associated restrictions on the overall health situation of people who use drugs. Understanding the changes in cannabis users’ patterns of use and health outcomes during France’s first lockdown could be very beneficial to understand current behaviors and adapt prevention messages. While some studies conducted during the first lockdown in other countries provided data for regular CU, they either focused on therapeutic use [24, 25], or were conducted in a context where national drug policy differs from that in France [26]. The purpose of our study was to investigate the impact of the first COVID-19 lockdown on daily cannabis users—whether recreational or therapeutic—in France. More specifically, we aimed to describe changes in their cannabis use, and to assess correlates associated with these changes.

Methods
Study design and participants
CANNAVID is a French, national, cross-sectional, web-based survey conducted between 17 April 2020 (one month after the country’s first lockdown started) and 11 May 2020 (the last day of the first lockdown). This community-based participatory research study was designed and implemented in collaboration with the harm reduction center ‘Bus 31/32’ and with cannabis users’ community associations. In order to solicit participation, the study was advertised through social media, cannabis community websites and mainstream press and radio. Eligibility criteria were being aged ≥18 years, living in France, and using cannabis daily. All participants received information before enrolment. Ethical approval was granted by the French national institute of health, and by the medical research ethics committee in Paris (IRB 00003888, N°20-676). The study did not receive external funding. No personal data which could have led to the identification of study participants (e.g., names, IP addresses) were collected.

Data collection and outcomes
Data were collected in a 15-min, self-administered questionnaire on a dedicated online platform (LimeSurvey.org). They were grouped into three different categories as follows: (i) sociodemographics: age, gender, education level (<secondary school diploma vs. ≥secondary school diploma), living with a partner during the lockdown (‘yes’/’no’), living with children during the lockdown (‘yes’/’no’), number of people living in the house (including the participant) before and during the lockdown, having an external space in one’s housing (e.g., large terrace, garden) (‘yes’/’no’) before and during lockdown, town/city of residence before and during lockdown; (ii) cannabis use (before and during the lockdown): median number of daily intakes, form used (dried flowers vs. resin vs. other (oil, e-liquid, etc.)), route of administration (smoking (joint with/without tobacco) vs. other (ingestion, vaporization)), supply route (home-grown cannabis vs. other), stocking up on cannabis before the lockdown (‘yes’/’no’), therapeutic use of cannabis before the lockdown (three categories: (1) ‘not always’, (2) ‘always’ and (3) ‘doesn’t known’ or...
unchanged employment status (whether employed receiving a payroll subsidy/job loss/sick leave/disability, eworking (since lockdown), (2) partial unemployment/a four-category employment variable as follows: (1) tel-visit lockdown ('increase' number of daily intakes by number of days) before and during the lockdown ('yes'/'no'), chronic or acute physical illness before the lockdown ('yes'/'no'), experiencing symptoms suggestive of COVID-19 since the beginning of the pandemic (i.e., fever, cough, sore throat, anosmia, ageusia, headache and dyspnea).

Using all these items we built the following variables:

Changes in cannabis use (principal outcome): To assess changes in cannabis use before and during the lockdown period, we compared the number of daily intakes between the two timeframes. A four-category variable was created as follows: (i) stopped, (ii) decreased, (iii) unchanged, and (iv) increased. This constituted the main exposure variable for the study. Participants were classed in the ‘stopped’ category if they completely stopped cannabis use during the first lockdown. The ‘decreased’ category included people who no longer used cannabis daily and those who reported daily cannabis use but fewer daily intakes than before the lockdown. Participants who reported the same daily cannabis use as before the lockdown were classed in the ‘unchanged’ category. Finally, the ‘increased’ category comprised participants who reported more daily intakes during the lockdown than before it. It is important to point out that we measured the number of daily intakes not the quantity of cannabis used daily.

Changes in the use of psychoactive substances other than cannabis: For each substance, we combined the number of intakes per day and the number of days per month and compared the monthly frequency (i.e., number of daily intakes by number of days) before and during lockdown (‘increase’ vs. ‘decrease or unchanged’).

Type of area of residence Using the French National Institute of Statistics and Economic Studies (INSEE) notion of the ‘urban unit’ [28], the type of town/city of residence was categorized into an urban (urban unit > 200 k inhabitants), semi-urban (urban unit between 10 and 200 k inhabitants) or rural (urban unit < 10 k inhabitants or rural town) area, according to INSEE’s data for 2020.

Change in employment status: We combined employment status before and during the first lockdown to build a four-category employment variable as follows: (1) teleworking (since lockdown), (2) partial unemployment/receiving a payroll subsidy/job loss/sick leave/disability, (3) unchanged employment status (whether employed or not) (reference category) and (4) student (before the lockdown only).

Symptoms suggestive of COVID-19: (1) ‘no symptoms’ (reference), (2) ‘mild symptoms’, (3) ‘dyspnoea’.

Health outcomes during lockdown: These included anxiety, depression, sleep disorder intensification and pain increase. Anxiety and depression were only measured for during the lockdown, not before it. We used the Hospital Anxiety and Depression (HAD) scale, with the commonly used cut-off score \( \geq 8 \) (‘yes’) to identify clinically-significant disorder for both conditions [29]. Participants who reported experiencing more sleep disorders during the lockdown than before it were classified as having sleep disorder intensification (‘yes’) versus all others (the same, fewer, no such disorders) (‘no’). Similarly, pain increase was defined as an increase in pain during the lockdown with respect to before it (‘yes’/’no’).

Statistical analysis
The first step of the analysis was to describe the characteristics of participants with respect to cannabis use changes using descriptive statistics according to several socio-demographic (during the lockdown), behavioral and health factors. We used a multinomial regression model to assess correlates of a change in cannabis use patterns using the four-category variable described above (i.e., the principal outcome). The ‘unchanged’ category was the reference comparison category for the other three categories (i.e., stopped, decreased, and increased). After performing a univariable analysis, we preselected variables which had at least one category associated with the outcome, defined by a \( p \) value < 0.10. We then built a multivariable model using a backward selection procedure to identify the best model by removing variables one at a time with a \( p \) value of > 0.05. Missing data for all covariates were treated as a separate category in the descriptive table and in the regression models.

Overall, 4279 participants completed questionnaires on the online platform. Of these, 134 were excluded because their town/city of residence during the first lockdown was located outside France. A further 126 were excluded because of missing data for cannabis use frequency before or during the lockdown. The study sample therefore comprised 4019 participants.

Results
Study sample
Respondents’ characteristics are described in Table 1. Men accounted for 74.0% of the sample and median age was 27 years (interquartile range (IQR): 22–37; min–max: 18–74 years). Most respondents had at least a secondary school diploma (82.0%) and were living in an urban area during the first lockdown (55.9%).
Table 1 Characteristics of respondents according to changes in cannabis use patterns during the first COVID-19-related lockdown in France

| Demographics                        | All (n = 4019) | Change in cannabis use during lockdown | p       |
|-------------------------------------|----------------|---------------------------------------|---------|
|                                     | n (%) or median [IQR] | Stopped (n = 293) | Reduced (n = 1153) | Unchanged (n = 1146) | Increased (n = 1427) |
| Women                               | 1045 (26.0)    | 64 (21.8) | 285 (24.7) | 256 (22.3) | 440 (30.8) ** |
| Age group (years)                   |                |           |           |           |               |
| 18 to 25 years                      | 1785 (44.4)    | 140 (47.8) | 587 (50.9) | 440 (38.4) | 618 (43.3) ** |
| 26 to 45 years                      | 1830 (45.5)    | 118 (40.3) | 477 (41.4) | 548 (47.8) | 687 (48.1)     |
| > 45 years                          | 404 (10.0)     | 35 (11.9) | 89 (7.7)  | 158 (13.8) | 122 (8.5)      |
| Education level ≥ secondary school diploma | 3294 (82.0)   | 249 (85.0) | 932 (80.8) | 898 (78.4) | 1215 (85.1) ** |
| Place of residence during lockdown |                |           |           |           |               |
| Rural                               | 607 (15.1)     | 44 (15.0) | 205 (17.8) | 178 (15.5) | 180 (12.6)     |
| Semi-urban                          | 1005 (25.0)    | 81 (27.6) | 340 (29.5) | 294 (25.6) | 290 (20.3)     |
| Urban                               | 2246 (55.9)    | 149 (50.8) | 562 (48.7) | 628 (54.8) | 907 (63.6)     |
| No. of people living in the house (incl. participant) during lockdown | 2 [2–4] | 3 [2–4] | 3 [2–4] | 2 [2–4] | 2 [2–4] ns |
| External space at home (terrace, garden) during lockdown | 2754 (68.5) | 218 (74.4) | 816 (70.8) | 805 (70.2) | 915 (64.1) ** |
| Living with a partner during lockdown | 1716 (42.7) | 98 (33.4) | 430 (37.3) | 545 (47.6) | 643 (45.1) ** |
| Had children during lockdown        | 956 (23.8)     | 61 (20.8) | 230 (19.9) | 345 (30.1) | 320 (22.4) ** |
| Change in employment activity/status during lockdown |                |           |           |           |               |
| Teleworking                         | 625 (15.5)     | 36 (12.3) | 146 (12.7) | 184 (16.1) | 259 (18.1)     |
| Partial unemployment or receiving payroll subsidy, job loss, sick leave or disability leave | 1667 (41.5) | 106 (36.2) | 427 (37.0) | 468 (40.8) | 666 (46.7)     |
| Unchanged                           | 939 (23.4)     | 78 (26.6) | 283 (24.5) | 328 (28.6) | 250 (17.5)     |
| Student                             | 666 (16.6)     | 68 (23.2) | 252 (21.9) | 132 (11.5) | 214 (15.0)     |
| State of health before lockdown     |                |           |           |           |               |
| Chronic or acute disease (physical health) | 522 (13.0) | 39 (13.3) | 140 (12.1) | 155 (13.5) | 188 (13.2) ns |
| Chronic or acute disease (mental health) | 385 (9.6) | 38 (13.0) | 124 (10.7) | 93 (8.1) | 130 (9.1) ns |
| Chronic pain                        | 853 (21.2)     | 57 (19.4) | 238 (20.6) | 258 (22.5) | 300 (21.0) ns |
| Self-medication with cannabis       |                |           |           |           |               |
| Not always                          | 2783 (69.2)    | 198 (67.6) | 819 (71.0) | 752 (65.6) | 1014 (71.1)    |
| Always                              | 436 (10.8)     | 32 (10.9) | 110 (9.5)  | 164 (14.3) | 130 (9.1)      |
| Missing                             | 800 (19.9)     | 63 (21.5) | 224 (19.4) | 230 (20.1) | 283 (19.8)     |
With regard to health, 13.0% had one or more reported chronic or acute pre-existing physical illnesses, while 9.6% had pre-existing chronic or acute mental health disorders. One in five reported prevalent chronic pain. Cannabis was mainly smoked (95.7%) and dried flowers were the most common form of administration (62.6%). Over one in ten participants reported always using cannabis for therapeutic purposes.

**Changes in cannabis use**
With regard to changes in cannabis use between before and during the first lockdown, 293 (7.3%) participants...
stopped, 1153 (28.7%) decreased, 1146 (28.5%) did not change, and 1427 (35.5%) increased their use. The latter reported a median of 2 (IQR: 1–4) additional intakes per day. The characteristics of respondents according to cannabis use changes are presented in Table 1. Several differences were found between the four cannabis user groups hereafter called ‘stopped’, ‘decreased’, ‘unchanged’ and ‘increased’. Among the statistically significant and most marked differences, we found more women in the increased group (30.8% vs. from 21.8 to 24.7%). The largest proportion of respondents aged over 45 years old was in the unchanged group (13.8% vs from 7.7 to 11.9%). Students were more frequent in the stopped group (23.2% vs. from 11.5 to 21.9%) and more people were teleworking (18.1% vs. from 12.3 to 16.1%) and unemployed (46.7% vs. from 36.2 to 40.8%) (whether partial or total) in the increased group. Respondents in the unchanged group were more likely to use cannabis exclusively for self-medication (14.3% vs. from 9.1 to 10.9%), to use a route of administration other than smoking (6.4% vs. from 2.4 to 3.8%), and to use home-grown cannabis (15.4% vs. from 3.1 to 9.2%). No differences were found in pre-lockdown cannabis use frequency (i.e., median number of daily intakes) across the four groups. Similarly, the prevalences of pre-lockdown mental illness, physical illness, and chronic pain were similar across groups. Stocking up on cannabis before the lockdown was widely reported in the increased group (57.0%) but not so in the stopped group (10.6%). Increased tobacco, alcohol and benzodiazepine use was less likely in the unchanged group. Finally, the unchanged group had the lowest rates of anxiety, sleep disorder intensification and increased pain.

Correlates of changes in cannabis use during lockdown

In the multivariable multinomial model (Table 2), we present adjusted relative-risk ratios (ARR) associated with changes in cannabis use, the 'unchanged' group being the reference.

Female gender and younger age were correlated with increased cannabis use as was having at least a secondary school diploma. Being a student, having switched to teleworking, and unemployment were all positively associated with increased cannabis use compared with persons with unchanged working practices. With regard to cannabis use, those who increased their number of intakes were less likely to use the drug exclusively for self-medication and were more likely to have stocked-up on it in expectation of the lockdown. They were also more likely to have increased tobacco, alcohol and benzodiazepine use during the lockdown. Finally, they were more likely to have experienced COVID-19-related symptoms, depression and sleep disorders during the lockdown.

Compared with participants with an unchanged level of cannabis use, those who decreased their use without stopping it were more likely to be under 45 and to be students. Instead, they were less likely to live in urban areas and to live with a partner. They were also less likely to use cannabis to self-medication, to grow cannabis at home and to have made pre-lockdown cannabis stock. Increased tobacco and alcohol use during lockdown was associated with decreased cannabis use. They were also more likely to self-report pre-lockdown anxiety or depression and to have experienced dyspnea, and sleep disorders intensification during lockdown.

Respondents who stopped cannabis use were less likely to be women and to be living with a partner, but more likely to have at least a secondary school diploma, to be a student and to have an external space in their house. They were less likely to grow cannabis at home and to have stocked-up cannabis before the first lockdown, but more likely to have increased tobacco, alcohol and benzodiazepine use during the lockdown. Furthermore, they were more likely to self-report pre-lockdown anxiety or depression, but less likely to report pre-lockdown chronic pain. Finally, they were more likely to have experienced depression, pain increase and sleep disorders intensification during lockdown.

Discussion

To our knowledge, this is the first study to investigate the impact of COVID-19 lockdown measures on a large sample of daily CU in France. In a context where all cannabis use was prohibited in the country at the time of the study, our findings reveal that the majority of respondents changed their cannabis use patterns. Specifically, over a third increased their daily number of intakes, while 36% decreased or completely stopped their use. These results are in line with a previous study performed in France from day 8 to day 13 (i.e., 24 March to 29 March 2020) of the first lockdown among 620 CU (frequency of intakes unknown) with 39.5%, 31.2% and 29.3% reporting no change, an increase, and decrease/cessation, respectively [4]. In the Netherlands, where cannabis-vending coffee shops were open for takeaway purchases during that country’s first lockdown a transversal study was performed among 1563 CU, 67.9% of whom were daily or almost daily users. That study showed that 41.3% of respondents reported increased cannabis use, 49.4% no change, and 6.6% a decrease [30]. Similarly, 38.4% of a sample of 1202 medical CU in the United States reported an increase in cannabis use since the start of the pandemic, 47.9% no change, and only 8.8% a decrease [25]. This suggests that the availability of cannabis is an important predictor of change in patterns of use. In our model, using
home-grown cannabis and having stocked-up cannabis were both negatively associated with a decrease or cessation of cannabis use. Furthermore, almost everyone in our sample who reported stopping cannabis use during France’s first lockdown did not stock up on the drug beforehand. Their cessation might therefore be explained by supply shortage. Conversely, those who increased their cannabis use were more likely to have stocked up. Interestingly, respondents in the ‘unchanged’ category were more likely to report home-grown cannabis for self-use, which suggests that self-supply may help when faced with difficulties in accessing cannabis. It must be remembered however that in France, growing one’s own supply

Table 2  Association between changes in cannabis use and health outcomes during France’s first COVID-19-related lockdown: multivariable logistic model

|                     | Stopped (vs. unchanged) | Reduced (vs. unchanged) | Increased (vs. unchanged) |
|---------------------|-------------------------|-------------------------|---------------------------|
|                     | aRRR [IC 95%]           | p                       | aRRR [IC 95%]             | p                       | aRRR [IC 95%]   | p               |
| Female              | 0.71 [0.50, 1.00]       | 0.050                   | 0.91 [0.74, 1.12]         | 0.385                   | 1.34 [1.10, 1.62] | 0.003           |
| Age group (years)   |                         |                         |                           |                         |                   |
| 18 to 25            | 0.84 [0.50, 1.41]       | 0.512                   | 1.61 [1.16, 2.24]         | 0.005                   | 1.45 [1.07, 1.97] | 0.018           |
| 26 to 45            | 0.88 [0.55, 1.41]       | 0.593                   | 1.44 [1.06, 1.95]         | 0.021                   | 1.39 [1.05, 1.84] | 0.021           |
| > 45                | Ref                     | Ref                     | Ref                       |                         |                   |
| Education level ≥ secondary school diploma | 1.67 [1.11, 2.51] | 0.014                  | 1.19 [0.94, 1.50]         | 0.155                   | 1.29 [1.03, 1.63] | 0.028           |
| Having an external space (terrace, garden) | 1.52 [1.09, 2.11] | 0.013                  | 1.13 [0.93, 1.37]         | 0.206                   | 0.88 [0.74, 1.06] | 0.178           |
| Type of area of residence (during lockdown)  |                     |                         |                           |                         |                   |
| Rural               | Ref                     | Ref                     | Ref                       |                         |                   |
| Semi urban          | 1.18 [0.75, 1.85]       | 0.482                   | 0.97 [0.74, 1.27]         | 0.813                   | 0.94 [0.72, 1.24] | 0.686           |
| Urban               | 1.00 [0.66, 1.53]       | 0.989                   | 0.73 [0.57, 0.94]         | 0.016                   | 1.22 [0.95, 1.57] | 0.112           |
| Living with a partner during lockdown | 0.72 [0.52, 0.98] | 0.036                  | 0.81 [0.68, 0.98]         | 0.026                   | 0.96 [0.80, 1.13] | 0.605           |
| Employment during lockdown |                     |                         |                           |                         |                   |
| Teleworking         | 0.91 [0.56, 1.49]       | 0.718                   | 0.95 [0.71, 1.26]         | 0.716                   | 1.52 [1.16, 1.98] | 0.002           |
| Partial unemployment or receiving payroll subsidy, job loss, sick leave or disability leave | 0.98 [0.69, 1.41] | 0.929                  | 1.01 [0.81, 1.25]         | 0.944                   | 1.76 [1.43, 2.18] | <0.001          |
| Unchanged           | Ref                     | Ref                     | Ref                       |                         |                   |
| Student             | 2.19 [1.36, 3.52]       | 0.001                   | 1.77 [1.31, 2.39]         | <0.001                  | 1.69 [1.24, 2.29] | 0.001           |
| Used cannabis exclusively to self-medicate |                     |                         |                           |                         |                   |
| No                  | Ref                     | Ref                     | Ref                       |                         |                   |
| Yes                 | 0.77 [0.47, 1.25]       | 0.289                   | 0.62 [0.46, 0.83]         | 0.002                   | 0.64 [0.48, 0.85] | 0.002           |
| Home-grown cannabis | 0.19 [0.09, 0.39]       | <0.001                  | 0.46 [0.34, 0.63]         | <0.001                  | 0.90 [0.69, 1.18] | 0.456           |
| Pre-lockdown cannabis stockpiling | 0.11 [0.08, 0.17] | <0.001                  | 0.78 [0.65, 0.93]         | 0.006                   | 1.38 [1.17, 1.64] | <0.001          |
| Increased tobacco use (during lockdown) | 3.07 [2.22, 4.24] | <0.001                  | 2.21 [1.76, 2.77]         | <0.001                  | 1.79 [1.44, 2.24] | <0.001          |
| Increased alcohol use (during lockdown) | 2.00 [1.47, 2.71] | <0.001                  | 1.29 [1.05, 1.58]         | 0.014                   | 1.61 [1.34, 1.95] | <0.001          |
| Increased benzodiazepine use (during lockdown) | 2.32 [1.08, 4.99] | 0.031                  | 1.57 [0.86, 2.89]         | 0.144                   | 1.67 [0.93, 2.99] | 0.085           |
| Symptoms suggestive of COVID-19 |                     |                         |                           |                         |                   |
| No                  | Ref                     | Ref                     | Ref                       |                         |                   |
| Mild symptoms without dyspnea | 0.75 [0.53, 1.06] | 0.106                  | 1.04 [0.85, 1.28]         | 0.683                   | 1.28 [1.05, 1.55] | 0.013           |
| Dyspnea             | 1.26 [0.67, 2.37]       | 0.471                   | 1.51 [1.04, 2.21]         | 0.031                   | 1.88 [1.32, 2.68] | <0.001          |
| Self-reported pre-lockdown chronic pathology or anxiety/depression |                     |                         |                           |                         |                   |
| No pathology other than anxiety or depression | 0.80 [0.46, 1.39] | 0.434                  | 1.10 [0.80, 1.49]         | 0.558                   | 1.20 [0.90, 1.60] | 0.213           |
| Anxiety or depression | 1.75 [1.02, 3.01] | 0.043                  | 1.53 [1.05, 2.23]         | 0.025                   | 1.02 [0.70, 1.47] | 0.931           |
| Self-reported pre-lockdown chronic pain | 0.51 [0.33, 0.77] | 0.002                  | 0.84 [0.66, 1.08]         | 0.174                   | 0.89 [0.71, 1.13] | 0.335           |
| Depression during lockdown (HAD score ≥ 8) | 1.46 [1.02, 2.07] | 0.036                  | 1.06 [0.83, 1.35]         | 0.660                   | 1.34 [1.07, 1.69] | 0.011           |
| Increased pain during lockdown | 1.90 [1.31, 2.75] | 0.001                  | 1.11 [0.86, 1.42]         | 0.424                   | 1.00 [0.79, 1.27] | 0.988           |
| Sleep disorder intensification during lockdown | 3.51 [2.56, 4.82] | <0.001                  | 1.80 [1.49, 2.18]         | <0.001                  | 1.35 [1.13, 1.62] | 0.001           

aRRR: adjusted relative-risk ratio; 95%CI: 95% confidence interval; p: p-value, HAD: Hospital Anxiety Depression, in bold : p < 0.05
means risking legal ramifications. Other countries have recently decided to legalize its recreational use. One example is Canada, where the effects of this policy are currently being evaluated [31].

We found other correlates of changes in cannabis use. Female gender and younger age were significantly associated with increased cannabis use, which is consistent with previous studies [4, 30]. In France, universities were closed during the first lockdown, and we found that being a student was significantly associated with an increase in cannabis use, but also a decrease and even cessation, indicating the differential impact of the lockdown on students. Working practices were also abruptly impacted by the lockdown, specifically an increase in teleworking and in unemployment [32]. In our study, persons who became unemployed during the lockdown were more likely to report an increase in cannabis use than those whose working practices remained unchanged. Using cannabis exclusively to self-medicate was a protective factor against increased or decreased cannabis use, suggesting that such CU have more stable consumption patterns and were less impacted by the lockdown and supply problems.

With regard to health outcomes in our study sample during the first lockdown, unchanged cannabis use was associated with lower prevalences of depression, sleep disorder intensification, and increased pain. One hypothesis for this is that for those who increased their cannabis use, this increase was a response to adverse health outcomes participants experienced, as cannabis is commonly used to therapeutically cope with these issues [33, 34]. Conversely, stopping cannabis use was associated with a higher prevalence of these three health outcomes, even after adjustment for various potential confounders. This is not surprising as these symptoms are typical of cannabis withdrawal [35]. This association suggests that cannabis cessation was more forced than desired for a proportion of the respondents. In addition, increased use of other psychoactive substances—specifically tobacco, alcohol and benzodiazepines—was more frequent in the group which stopped cannabis use. More research is needed to evaluate whether these changes in consumption continued after the first lockdown ended. In the general population, mental health was significantly affected by the pandemic, especially during lockdown periods [36]. Thus, links between mental health outcomes and cannabis use changes might have been influenced by the crisis itself. This may explain the meaningful increase of alcohol use across all groups of cannabis changes.

Our study has limitations. First, the online recruitment method used may have led to selection bias, in particular underrepresentation of people not proficient in computing skills and those without internet access. The representativeness of our sample can only be partially assessed by comparing our results with those from the only other French study to include daily CU to date [12]. Although that study—based on a representative sample of the general population—only detailed gender and age distribution, the values for socio-demographic characteristics found were similar to ours (i.e., mostly men and a younger population). Second, to ensure the length of the questionnaire was acceptable, we chose only a small number validated scales and used only one question to measure pain increase and one for intensification of sleep disorders. Third, given that cannabis use is illegal in France, individuals may have been reluctant to participate due to fear of legal actions. However, we guaranteed complete anonymity through our secured platform. Finally, the cross-sectional nature of our data prevented us from making assumptions about causal relationships. Nevertheless, our findings provide useful information about the impact of the first COVID-19 lockdown in France on daily CU.
Conclusions
We highlighted the differential impact of France’s first COVID-19-related lockdown on daily CU. Cannabis use patterns changed for the majority of respondents, with 35.5% increasing and 36% decreasing or stopping their use. We found several factors associated with changes in cannabis use, providing us with a greater understanding of the behavioral and health consequences of COVID-19-lockdowns in daily CU. In a context where the pandemic is still ongoing, these findings could be very useful for clinicians and decision-makers when designing and implementing strategies to mitigate adverse health outcomes, including expanded access to healthcare, harm reduction interventions and policy changes.

Abbreviations
COVID-19: Coronavirus disease 2019; CU: Cannabis users; IRB: Institutional Review Board, AUDIT-C: Alcohol Use Disorders Identification Test; INSEE: French National Institute of Statistics and Economic Studies; HAD: Hospital and Anxiety Hospital; IQR: Interquartile range; RRR: Relative-risks ratios; IORG: International Organizations Research Group; FWA: Federal wide Assurance.

Acknowledgements
We thank all the study participants and community associations involved in recruiting them. We also thank the members of the scientific committee (Laurent Appel, Martin Bastien, Laëlia Brand Madrid, Cécile Donadille, Claire Duport, Muriel Grégoire, Maëla Le Brun Gadelius, Victor Martin, Salim Mezaache, Perrine Roux, Bruno Spire). Finally, our thanks to Jude Sweeney (Milan, Italy) for the English revision and copyediting of our manuscript.

Public involvement in research: This study was grounded in community-based participatory research. People from the cannabis-using community were involved in all steps of the study (enrolment, conception of the research questions, interpretation of the results).

Authors’ contributions
SM, VM, MLG, LA, LBM, BS, and PR contributed to the study’s conception. SM, CD, VM, LA, LBM, BS, and PR contributed to its design. SM, VM, MLG, LA participated in the data collection while SM, CD, and PR conducted the analyses. SM, PR, and MB conducted the literature review, and SM drafted the first version of the manuscript, supervised by PR. All authors read and approved the final manuscript.

Funding
Own funding from our research unit.

Availability of data and materials
The datasets used and analyzed for the current study are available from the corresponding author on reasonable request (perrine.roux@inserm.fr).

Declarations
Ethics approval and consent to participate
All participants received information before enrolment and provided oral consent. No signed consent was requested to ensure participants’ anonymity (Yoshida et al., 2013). Moreover, no other personal data which could have led to the identification of the study participants (e.g., names, IP addresses) were collected. Ethical approval was granted by the French Inserm National Ethics Committee (RB0003888; IORG003254; FWA0005831) under the number N°20-676.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no conflict of interest.

Author details
1 Sciences économiques & sociales de la santé & traitement de l’information médicale, Aix-Marseille Univ, INSERM, IRD, SESSTIM, Marseille, France. 2 Association Bus 31/32, Marseille, France. 3 Faculté de médecine, INSERM U1252 SESSTIM, 27 bd Jean Moulin, Marseille, France.

Received: 8 October 2021 Accepted: 4 March 2022
Published online: 15 March 2022

References
1. Davies NG, Kucharski AJ, Eggo RM, Gimma A, Edmunds WJ, Jombart T, et al. Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modelling study. Lancet Public Health. 2020.
2. Décret n° 2020-293 du 23 mars 2020 prescrivant les mesures générales nécessaires pour faire face à l’épidémie de covid-19 dans le cadre de l’état d’urgence sanitaire. Mar 23, 2020.
3. Décret n° 2020-264 du 17 mars 2020 portant création d’une contravention réprimant la violation des mesures destinées à prévenir et limiter les conséquences des menaces sanitaires graves sur la santé de la population. 2020-264 Mar 17, 2020.
4. 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. JMI Public Health Surveill. 2020;6(3):e19630.
5. Pullano G, Valdano E, Scarpa N, Rubrichi S, Colizza V. Evaluating the impact of demographic, socioeconomic factors, and risk aversion on mobility during COVID-19 epidemic in France under lockdown: a population-based study. medRxiv. 2020;2020.05.29.20097097.
6. Gérome C, Gandilhon M. Evolution des usages et de l’offre de drogues médicamenteuses par les Québécois au temps du COVID-19 : observations croisées du dispositif TREND. Saint-Denis: Observatoire Français des Drogues et des Toxicomanies; 2020. p. 20. (Bulletin TREND-COVID19). Report No: 2. https://www.ofdt.fr/BDD/publications/docs/Bulletin-TREND-COVID-2.pdf.
7. Lapeyre-Mestre M, Boucher A, Daveluy A, Gibaja V, Jouanujs E, Mallaret M, et al. Addictovigilance contribution during COVID-19 epidemic and lockdown in France. Therapies. 2020;75(4):343–54.
8. Palamar JJ, Le A, Carr TH, Cottler LB. Shifts in drug seizures in the United States during the COVID-19 pandemic. Drug Alcohol Depend. 2021;221:108580.
9. Manthey J, Kilian C, Carr S, Bartak M, Bloomfield K, Bradick F, et al. Use of alcohol, tobacco, cannabis, and other substances during the first wave of the SARS-CoV-2 pandemic in Europe: a survey on 36,000 European substance users. Subst Abuse Treat Prev Policy. 2021;16(1):36.
10. Vanderbruggen N, Matthys F, Van Laere S, Zeeuws D, Santermans L, Van den Aemeele 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(6):309–15.
11. Jacob L, Smith L, Armstrong NC, Yakkundi A, Barnett Y, Butler L, et al. Alcohol use and mental health during COVID-19 lockdown: a cross-sectional study in a sample of UK adults. Drug Alcohol Depend. 2021;219:108488.
12. Spilka S, Richard J-B, Le Nézet O, Janssen E, Brissot A, Philippion A, et al. Les niveaux d’usage des drogues illicites en France en 2017 [Internet]. Saint-Denis: Observatoire Français des Drogues et des Toxicomanies; 2018. p. 4. (Tendances). https://www.ofdt.fr/BDD/publications/docs/eftxsyb.pdf.
13. Green B, Kavanagh D, Young R. Being stoned: a review of self-reported cannabis effects. Drug Alcohol Rev. 2003;22(4):453–60.
14. Campanry E, López-Pelayo H, Nutt D, Blithkioti C, Oliveras C, Nuño L, et al. The blind men and the elephant: Systematic review of systematic reviews of cannabis use related health harms. Eur Neuropsychopharmacol. 2020;33:1–35.
15. Karla L, Roux P, Rolland B, Benyamina A, Reynaud M, Aubin H-J, et al. Acute and long-term effects of cannabis use: a review. Curr Pharm Des. 2014;20(25):4112–8.
16. Lynch ME, Campbell F. Cannabinoids for treatment of chronic non-cancer pain: a systematic review of randomized trials. Br J Clin Pharmacol. 2011;72(5):735–44.
17. Koppel BS, Brust JCM, Fife T, Bronstein J, Yound S, Gronseth G, et al. Systematic review: efficacy and safety of medical marijuana in selected neurologic disorders: report of the Guideline Development Subcommittee of the American Academy of Neurology. Neurology. 2014;82(17):1556–63.
18. Smith LA, Azariah F, Lavender VTC, Stoner NS, Bettiol O. Cannabis for nausea and vomiting in adults with cancer receiving chemotherapy. Cochrane Database Syst Rev. 2015;11:009464.
19. Ogborne AC, Smart RG, Weber T, Birchmore-Timney C. Who is using cannabis as a medicine and why: an exploratory study. J Psychoactive Drugs. 2000;32(4):435–43.
20. Aviram J, Samuely-Leichtag G. Efficacy of cannabis-based medicines for pain management: a systematic review and meta-analysis of randomized controlled trials. Pain Physician. 2017;20(6):E755–96.
21. Babson KA, Sottile J, Moralito D. Cannabis, cannabinoids, and sleep: a review of the literature. Curr Psychiatry Rep. 2017;19(4):23.
22. Donovan KA, Portman DG. Effect of COVID-19 pandemic on cannabis use in cannabis patients. Am J Hosp Palliat Care. 2021;39(7):909–10.
23. Farrimond JA, Mercier MS, Whalley BJ, Williams CM. Cannabis sativa and the endogenous cannabinoid system: therapeutic potential for appetite regulation. Phytother Res. 2011;25(2):170–88.
24. Donovan KA, Portman DG. Effect of COVID-19 pandemic on cannabis use in cancer patients. Am J Hosp Palliat Care. 2021;39(7):909–10.
25. Vidot DC, Islam JY, Marlene Camacho-Rivera, Harrell MB, Rao DR, Chavez JV, 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. 2021;39(1):26–36.
26. Cousins J, Kuhns L, Larsen H, Kroon E. For better or for worse? A pre-post exploration of the impact of the COVID-19 lockdown on cannabis users. Addiction. 2021.
27. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. Arch Intern Med. 1998;158(16):1789–95.
28. Rey G, Jougla E, Fouillet A, Hémon D. Ecological association between a deprivation index and mortality in France over the period 1997–2001: variations with spatial scale, degree of urbanicity, age, gender and cause of death. BMC Public Health. 2009;9:33.
29. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67(6):361–70.
30. van Laar MW, Oomen PE, van Miltenburg CJA, Vercoulen E, Freeman TP, Hall WD. Cannabis and COVID-19: reasons for concern. Front Psychiatry. 2020. https://doi.org/10.3389/fpsyt.2020.601653/full.
31. Fischer B, Russell C, Rehm J, Leese P. Assessing the public health impact of cannabis legalization in Canada: core outcome indicators towards an ‘index’ for monitoring and evaluation. J Public Health (Oxf). 2019;41(2):412–21.
32. Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. Arch Intern Med. 1998;158(16):1789–95.
33. Sexton M, Cutler C, Finnell JS, Mischley IK. A cross-sectional survey of medical cannabis users: patterns of use and perceived efficacy. Cannabis Cannabinoid Res. 2016;1(1):131–8.
34. Botsford SL, Yang S, George TP. Cannabis and cannabinoids in mood and anxiety disorders: impact on illness onset and course, and assessment of therapeutic potential. Am J Addict. 2020;29(1):9–26.
35. Gorelick DA, Levin KH, Copersino ML, Heishman SJ, Liu F, Boggis DL et al. Diagnostic criteria for cannabis withdrawal syndrome. Drug Alcohol Depend. 2012;123(1–3):141–7.
36. Niedzwiedz CL, Green MJ, Benzeval M, Campbell D, Craig P, Demou E, et al. Mental health and health behaviours before and during the initial phase of the COVID-19 lockdown: longitudinal analyses of the UK Household Longitudinal Study. J Epidemiol Community Health. 2021;75(3):224–51.
37. Webster P. Virtual health care in the era of COVID-19. The Lancet. 2020;395(10231):1180–1.
38. Soron TR, Shaniful Islam SM, Ahmed HU, Ahmed SI. The hope and hype of telepsychiatry during the COVID-19 pandemic. Lancet Psychiatry. 2020;7(8):e50.
39. Van Boekel LC, Brouwers EPM, Van Weeghel J, Garretsen HFL. Stigma among health professionals towards patients with substance use disorders and its consequences for healthcare delivery: Systematic review. Drug Alcohol Depend. 2013;131(1):23–35.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.