


# Cannabidiol use in France in 2022: Results from a nationwide representative sample of adults

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## Abstract

**Introduction:** Cannabidiol (CBD) is a non-intoxicating cannabis compound found in diverse commercial products worldwide. However, its use may not be fully harmless. Accordingly, it is important to document the prevalence of CBD use and user characteristics in the general population.

**Methods:** We conducted a nationwide survey from a random sample of adults living in France using computer-assisted telephone interviews between 2 March and 9 July 2022. We estimated the prevalence of CBD awareness and CBD use, and explored the different routes of administration. We also performed logistic regression models to identify factors associated with past-year CBD use.

**Results:** Based on data from 3229 participants, we estimated that 71.0% (95% confidence interval) (69.0–73.0) of the French adult population had heard of CBD, and 10.1% (8.7–11.4) had used it in the previous year. Past-year CBD use was associated with younger age, a higher educational level, not living in a middle-sized urban unit, tobacco consumption and e-cigarette use. The most common route of administration was smoking (56.1%).

**Discussion and Conclusion:** Past-year CBD use prevalence in France appeared to be as high as that for cannabis. Proper prevention, regulation and control of CBD products is necessary to ensure that people have access to safe and high-quality products. Reliable information on CBD should be sought and disseminated, especially regarding the harms associated with smoking the compound.

## KEYWORDS

cannabidiol, cannabinoid, France, smoking, tobacco

## Key Points

- Cannabidiol is easily accessible in France and Europe.
- Cannabidiol use may come with certain risks.
- Ten percent of French adults used cannabidiol in the previous year.
- The most common route of cannabidiol administration was smoking.

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## 1 | INTRODUCTION

Cannabidiol (CBD) is one of the two most abundant cannabinoids in cannabis [1]. According to the World Health Organisation, CBD exhibits no effects indicative of any abuse or dependence potential, and there is no evidence that the use of pure CBD is associated with any public health-related problems [2]. Unlike tetrahydrocannabinol (THC), CBD is non-intoxicating [3]. This safety profile [4] has spurred the development of a global market, which was estimated at USD 6.4 billion in 2022 [5].

As CBD is a cannabis-derived compound, it continues to be the subject of numerous legal twists and turns, which in turn fuel misconceptions, especially regarding its legality and harmfulness. In the context of the EU, the need for a unified regulatory framework has been highlighted [6, 7]. Currently, CBD products sold in the bloc cannot be marketed as health products for disease prevention or treatment, as this is the prerogative of officially recognised medicinal products [8]. They are therefore generally sold as wellness or complimentary health products.

Despite the issue of legality, the supposed disease prevention and treatment benefits of CBD are nonetheless communicated on social media, non-EU commercial websites and other media [9, 10]. Well-being and symptom alleviation are commonly reported as reasons to use CBD [11, 12], and the element of naturalness attributed to this cannabinoid may promote a positive perception of it [13].

Despite its safety profile, CBD use comes with certain risks. It is a multi-target bioactive compound [14]. Dry mouth, euphoria and hunger are commonly reported by users [15]. Adverse effects from clinical trials testing high doses include diarrhoea, fatigue, somnolence and elevation of hepatic enzymes [4, 16]. There is also concern about interactions between CBD and cytochrome P450 enzymes, leading to potential changes in the effects of co-administered drugs [17]. However, knowledge gaps exist about specific drug dose responses and individual pharmacokinetic profiles [18]. Moreover, clinical data on the impact of CBD use during pregnancy and breastfeeding are lacking [19]. National institutions advise against its use in these circumstances [20–22]. Another concern regards the true quantity of cannabinoids in CBD-based products [23]. Specifically, labels on CBD products may give inaccurate information about CBD content [24–26] and unregulated products may present substantial THC levels [27]. Contamination with heavy metals or synthetic cannabinoid has also been reported [28, 29]. Finally, the smoking-based route of administration (i.e., combustion of CBD-rich cannabis flowers) is a risk factor for lung disease, as cannabis smoke is qualitatively similar to tobacco smoke and has even more particulate matter [30].

Given this context, there is a need to estimate CBD use prevalence and to characterise it in order to properly assess the related public health risk, with a view to better orienting public health messages. In France, only one assessment of CBD use prevalence has been published to date [31]. However, that survey—conducted in December 2021—did not use random sampling and provided no data on the route of administration.

The present study aimed to provide an updated estimate of the prevalence of CBD use in France, as well as to identify the factors associated with this use. We also aimed to highlight the preferred routes of CBD administration by French users.

## 2 | METHODS

### 2.1 | Design

The present survey was conducted by the French national public health agency (*Santé Publique France*) between 2 March and 9 July 2022, based on the 2021 French Health Barometer survey methodology [32]. The main objective was to estimate the prevalence of tobacco smoking in France in 2022 and to describe recent trends [33].

The survey method was based on the random generation of landline and mobile telephone numbers, in order to include people with private numbers. Participants were selected using a two-stage random survey of landlines (random generation of number followed by random selection of one eligible individual per household), and a one-stage random survey of mobile lines (interviewing the person who answered the phone). The questionnaire was delivered using the computer-assisted telephone interview system, whereby the interviewer conducts the interview over the telephone and follows a pre-established script on a personal computer screen.

Individuals had to provide full consent to participate in the survey and consent to the processing of personal data, including their personal health data. In accordance with French law (article R 1121-1 of the French national health code), the Data Protection Officer from *Santé publique France* confirmed that approval from a national ethics committee was not necessary, as the survey was not legally considered to be research involving human beings. Indeed, the aim of the survey was to produce an aggregated overview of French people's behaviours and knowledge.

### 2.2 | Participants

The survey was conducted among 18–75 year-old individuals residing in mainland France who spoke French.

Residents of collective dwellings and institutions were excluded from the target population.

## 2.3 | Sample size

The principal objective of the survey was to study tobacco smoking in the general adult population. The most recent national estimates on smoking indicated that approximately a quarter of French adults were daily smokers. The targeted sample size ( $n = 3000$ ) was calculated such that a significant difference of between 2 and 3 percentage points could be observed between 2021 and 2022 [34]. A larger sample size would have provided more precision but at a much greater study cost.

## 2.4 | Data collection

The mean questionnaire completion time was 11 min. Sociodemographic data collected included age, sex, employment status, highest educational diploma obtained, self-perceived household economic status, household incomes and composition, region of residence and urban unit size (a French statistical measurement of contiguously built-up areas) [35]. Substance use data included tobacco cigarette and electronic cigarette use. Five questions were dedicated to CBD: awareness of it, lifetime use, past-year use, age at first use and route of administration ('The last time you consumed it, did you...?'), with the following possible answers: smoke it/vape it/take it orally/other).

## 2.5 | Data weighting

To improve the representativeness of the estimates, data were weighted. Final weights were based on an initial weighting that took account of the probability of inclusion. This probability depended on the number of eligible people and the number of telephone lines (landline or mobile) within the household. This initial weighting was followed by a margin calibration based on the structure of the population of mainland France for the following variables: the sex variable crossed with age in decennial bands, household composition, highest educational diploma, region of residence and size of urban unit (based on 2020 data [36]). The margin calibration provided the final weights.

## 2.6 | Outcome

For the present analysis, the primary outcome was responding 'Yes' to the question 'Have you consumed CBD in the last 12 months?'

## 2.7 | Explanatory variables

Age was tested as a continuous variable. Employment status was dichotomised into having a job or not. The highest educational diploma obtained was categorised into '<upper secondary school certificate', 'upper secondary school certificate' and 'tertiary education diploma'. Self-perceived household economic status was assessed by answering the question 'Presently, would you say that, in your household, financially speaking...' (possible answers: 'You are comfortable', 'You are ok', 'You just get by', 'It's difficult to make ends meet', 'You can't manage without going into debt (or using consumer credit)' [37]). Urban unit size was categorised into small, medium and large urban units, corresponding to <20,000, 20,000–199,999 and  $\geq 200,000$  inhabitants, respectively. Current tobacco smoking was categorised as 'none', 'non-daily' and 'daily'. Current electronic cigarette use was categorised as 'yes' and 'no'.

## 2.8 | Statistical analyses

Study sample characteristics were compared according to answers to the questions 'Have you ever heard of CBD or cannabidiol?', 'Have you ever consumed CBD', and the primary outcome question (see above), using the Rao-Scott chi-square (for categorical variables) and weighted Mann-Whitney (for numerical variables) tests. The weighted prevalence of CBD use was compared between response modalities for each descriptive variable (Rao-Scott chi-square test).

To identify factors associated with past-year CBD use, we performed weighted binary logistic regressions. Associations were assessed using odds ratios in bivariable analyses, and adjusted odds ratios (aOR) in multivariable analysis. Regression models were run on weighted data.

Past-year CBD user characteristics were also compared according to the route of administration using Rao-Scott chi-square tests on weighted data. Due to too low a number of 'vaping' and 'other' responses, the route of administration variable was dichotomised into 'inhalation' (i.e., smoking or vaping) versus other routes (i.e., oral or other) to enable comparison tests.

**TABLE 1** Study sample characteristics according to awareness and use of cannabidiol (*n* = 3229).

Variables (missing values) %, weighted	Had heard of CBD			Lifetime CBD use			Past-year CBD use			Prevalence of past-year CBD use % (95% CI), weighted <sup>b</sup>		
	Total sample	No (29.0%)	Yes (71.0%)	<i>p</i> -value <sup>a</sup>	Column %, weighted	No (83.6%)	Yes (16.4%)	<i>p</i> -value <sup>a</sup>	Column %, weighted		No (89.9%)	Yes (10.1%)
Sex				0.917				0.015				0.918
Male	48.6	48.4	48.6		47.3	54.7			48.5	48.9		10.1 (8.4–12.2) <sup>a</sup>
Female	51.5	51.6	51.4		52.7	45.3			51.5	51.1		10.0 (8.3–11.9) <sup>a</sup>
Age, years				0.001				<0.001				<0.001
18–29	19.8	11.6	23.1		17.0	34.1			17.8	37.2		18.9 (15.5–23)
29–44	25.8	19.9	28.2		24.0	35.5			24.8	35.6		13.9 (11.0–17.3)
45–59	27.9	26.3	28.5		29.4	19.8			29.1	16.6		6.0 (4.3–8.2) <sup>a</sup>
≥60	26.5	42.1	20.2		29.7	10.7			28.3	10.6		4.0 (2.7–6.0) <sup>a</sup>
Median (interquartile range)	47 (33–60)	55 (40–67)	43 (31–57)	<0.001	49 (35–62)	36 (26–48)			48 (34–61)	35 (25–46)		<0.001
Employed (1)				<0.001				<0.001				0.045
No	41.5	55.9	35.6		43.4	31.9			42.3	35.0		8.5 (6.8–10.6)
Yes	58.5	44.1	64.4		56.6	68.1			57.8	65.1		11.2 (9.5–13.1)
Educational level (17)				<0.001				0.013				0.005
<Upper secondary school certificate	43.9	59.9	37.4		45.2	37.0			45.1	33.1		7.6 (5.8–9.9)
Upper secondary school certificate	21.1	16.2	23.1		21.0	21.6			20.8	23.4		11.1 (8.6–14.3) <sup>a</sup>
Tertiary education diploma	35.0	23.9	39.6		33.8	41.4			34.1	43.5		12.5 (10.5–14.8) <sup>a</sup>
“Presently, would you say that in your household, financially speaking...?” (46)				0.182				0.351				0.160
You are comfortable	17.2	16.0	17.7		17.1	17.5			16.8	20.1		11.9 (9.0–15.7) <sup>a</sup>
You are ok	41.9	40.4	42.4		42.4	39.4			42.2	39.3		9.5 (7.8–11.7) <sup>a</sup>
You just get by	26.0	25.9	26.1		26.2	25.0			26.5	21.8		8.5 (6.4–11.2) <sup>a</sup>
It's difficult to make ends meet/You can't	14.9	17.7	13.8		14.3	18.1			14.5	18.8		12.8 (9.2–17.5) <sup>a</sup>

(Continues)

TABLE 1 (Continued)

Variables (missing values) %, weighted	Had heard of CBD			Lifetime CBD use			Past-year CBD use			Prevalence of past-year CBD use % (95% CI), weighted <sup>b</sup>	
	Total sample %	No (29.0%)	Yes (71.0%) p-value <sup>a</sup>	Column %, weighted	No (83.6%)	Yes (16.4%) p-value <sup>a</sup>	Column %, weighted	No (89.9%)	Yes (10.1%) p-value <sup>a</sup>		Column %, weighted
manage without going into debt (or using consumer credit) <sup>c</sup>			0.970			0.473				0.007	
Urban unit size (number of inhabitants) (33)											
<20,000	40.0	40.4	39.9	40.5	38.0	38.0	40.2	38.9	38.9	38.9	9.9 (7.9–12.3) <sup>a</sup>
20,000–199,999	18.5	18.2	18.6	18.7	17.5	17.5	19.3	11.4	11.4	11.4	6.3 (4.3–9.1)
≥200,000	41.5	41.4	41.6	40.9	44.5	44.5	40.6	49.7	49.7	49.7	12.2 (10.2–14.5) <sup>a</sup>
Tobacco use (6)											
Non-user	68.9	76.5	65.8	75.0	38.0	38.0	72.9	33.7	33.7	33.7	4.9 (3.9–6.1)
Non-daily user	6.6	4.1	7.6	5.5	12.2	12.2	5.7	14.6	14.6	14.6	22.0 (16.2–29.2) <sup>a</sup>
Daily user	24.5	19.4	26.6	19.5	49.9	49.9	21.4	51.8	51.8	51.8	21.1 (17.6–25.2) <sup>a</sup>
Electronic cigarette use											
Non-user	92.7	95.6	91.6	94.4	84.4	84.4	93.9	81.8	81.8	81.8	8.9 (7.7–10.3)
User	7.3	4.4	8.4	5.7	15.6	15.6	6.1	18.2	18.2	18.2	25.1 (19.0–32.5)

Note: Data were weighted according to the probability of inclusion, followed by a margin calibration using the sex variable crossed with age in decennial bands, household size, educational qualification, region of residence and size of urban unit (based on 2020 data [36]).

Abbreviations: CBD, cannabidiol; CI, confidence interval.

<sup>a</sup>Rao-Scott chi-square test, except for continuous age (weighted Mann–Whitney test).

<sup>b</sup>Common superscript letters denote prevalences not statistically different between modalities.

<sup>c</sup>It's difficult to make ends meet' and 'You can't manage without going into debt' were merged as there were only 89 respondents for the latter modality.

**TABLE 2** Factors associated with past-year cannabidiol use in a French nationwide sample of 18–75 year-olds.

Variables	Bivariable analyses (n = 3229)		Multivariable analysis (n = 3143)	
	OR (95% CI)	p-value	aOR (95% CI)	p-value
Sex				
Male (ref.)	1			
Female	0.98 (0.74–1.32)	0.918	1.03 (0.76–1.41)	0.846
Age, years	0.96 (0.95–0.97)	<0.001	0.97 (0.96–0.98)	<0.001
Employed				
No (ref.)	1		1	
Yes	1.36 (1.01–1.84)	0.045	0.90 (0.64–1.27)	0.565
Educational level				
<Upper secondary school certificate (ref.)	1		1	
Upper secondary school certificate	1.52 (1.01–2.29)	0.043	1.22 (0.78–1.93)	0.381
Tertiary education diploma	1.74 (1.22–2.46)	0.002	1.73 (1.14–2.61)	0.009
“Presently, would you say that in your household, financially speaking...”				
You are comfortable (ref.)	1		1	
You are ok	0.78 (0.53–1.15)	0.211	0.91 (0.60–1.40)	0.678
You just get by	0.69 (0.44–1.07)	0.095	0.71 (0.44–1.17)	0.179
It's difficult to make ends meet/You can't manage without going into debt (or using consumer credit) <sup>a</sup>	1.08 (0.66–1.77)	0.750	0.96 (0.57–1.63)	0.888
Urban unit size (number of inhabitants)				
<20,000	1.63 (1.02–2.60)	0.042	2.09 (1.26–3.47)	0.004
20,000–199,999 (ref.)	1		1	
≥200,000	2.06 (1.32–3.22)	0.002	2.00 (1.24–3.21)	0.004
Tobacco use				
Non-user (ref.)	1		1	
Non-daily user	5.51 (3.54–8.59)	<0.001	3.57 (2.15–5.93)	<0.001
Daily user	5.23 (3.78–7.24)	<0.001	4.98 (3.51–7.06)	<0.001
Electronic cigarette use				
Non-user (ref.)	1		1	
User	3.45 (2.33–5.12)	<0.001	2.07 (1.29–3.32)	0.003

Note: Data were weighted according to the probability of inclusion, followed by a margin calibration using the sex variable crossed with age in decennial bands, household size, educational qualification, region of residence, and size of urban unit (based on 2020 data [36]).

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ref., reference.

<sup>a</sup>‘It's difficult to make ends meet’ and ‘You can't manage without going into debt’ were merged as there were only 89 respondents for the latter modality.

Analyses were performed with Stata software version 17.0 (StataCorp LP, College Station, TX, USA).

### 3 | RESULTS

#### 3.1 | Prevalence of CBD use

The response rate was 52%. The study sample included 3229 participants whose characteristics are provided in

Table 1. We estimated that 71.0% (95% confidence interval) (69.0–73.0) of the French adult population had heard of CBD, 16.4% (14.8–18.1) had used it in their lifetime, and 10.1% (8.7–11.4) had used it in the previous year. Past-year CBD use prevalence was higher among 18–44 year-olds (16.1% vs. 5.0% for ≥45 years,  $p < 0.001$ ), employed persons (11.2% vs. 8.5% for people not employed,  $p = 0.045$ ), the most educated participants (12.5% vs. 7.6% for the least educated ones,  $p = 0.002$ ), persons living in a large urban unit (12.2% vs. 6.3% for people living in a medium urban unit,

TABLE 3 Past-year cannabidiol user characteristics according to route of administration ( $n = 291$ ).

Variables (missing values)	All past-year users %, weighted	Route of cannabidiol administration		<i>p</i> -value <sup>a</sup>
		Inhalation (smoked or vaped) (64.2%) Column %, weighted	Other (35.8%)	
Sex				0.001
Male	48.9	58.1	32.3	
Female	51.1	41.9	67.7	
Age, years				<0.001
18–29	37.2	47.5	18.8	
29–44	35.6	37.0	33.2	
45–59	16.6	10.7	27.2	
≥60	10.6	4.9	20.8	
Median (interquartile range)	35 (25–46)	30 (24–40)	43 (32–57)	<0.001 <sup>b</sup>
Employed				0.316
No	35.0	37.4	30.5	
Yes	65.1	62.6	69.5	
Educational level (2)				0.317
<Upper secondary school certificate	33.1	34.3	30.9	
Upper secondary school certificate	23.4	25.9	18.7	
Tertiary education diploma	43.5	39.7	50.4	
“Presently, would you say that within your household, financially speaking...” (2)				0.057
You are comfortable	20.1	18.2	23.7	
You are ok	39.3	35.4	46.4	
You just get by	21.8	22.5	20.5	
It’s difficult to make ends meet/You can’t manage without going into debt (or using consumer credit) <sup>c</sup>	18.8	24.0	9.4	
Urban unit size (number of inhabitants) (1)				0.407
<20,000	38.9	35.6	45.0	
20,000–199,999	11.4	11.8	10.8	
≥200,000	49.7	52.7	44.2	
Tobacco use (2)				<0.001
Non-user	33.7	20.3	57.4	
Non-daily user	14.6	14.1	15.4	
Daily user	51.8	65.6	27.3	
Electronic cigarette use				0.011
Non-user	81.8	76.9	90.6	
User	18.2	23.1	9.5	
Age at cannabidiol use initiation				<0.001
Same age as at time of survey	33.5	25.1	48.5	
Age at time of survey minus 1 year	35.8	37.3	33.1	
Age at time of survey minus 2 years	12.9	15.3	8.6	

TABLE 3 (Continued)

Variables (missing values)	All past-year users %, weighted	Route of cannabidiol administration		p-value <sup>a</sup>
		Inhalation (smoked or vaped) (64.2%)		
		Other (35.8%)		
Age at time of survey minus three or more years	17.8	22.3	9.8	
Route of administration during most recent use of cannabidiol				
Smoked	56.1	–	–	
Vaped	8.1	–	–	
Oral administration	34.0	–	–	
Other	1.8	–	–	

Note: Data were weighted according to the probability of inclusion, followed by a margin calibration using the sex variable crossed with age in decennial bands, household size, educational qualification, region of residence and size of urban unit (based on 2020 data [36]).

<sup>a</sup>Rao-Scott chi-square test, except for age as a continuous variable.

<sup>b</sup>Weighted Mann-Whitney test.

<sup>c</sup>'It's difficult to make ends meet' and 'You can't manage without going into debt' were merged as there were only 10 respondents for the latter modality.

$p = 0.001$ ), and tobacco (21.5% vs. 4.9% for non-users,  $p < 0.001$ ) and e-cigarette users (25.1% vs. 8.9% for non-users,  $p < 0.001$ ).

### 3.2 | Factors associated with past-year CBD use

After multiple adjustment, past-year use was associated with younger age (aOR 0.97 per 1-year increase,  $p < 0.001$ ), having a tertiary educational diploma (aOR 1.73 vs. <upper secondary school certificate,  $p = 0.009$ ), not living in a medium urban unit (aOR 2.09 and 2.00 for small and large urban units,  $p = 0.004$  and  $p = 0.004$ , respectively), tobacco use (aOR 3.57 and 4.98 for non-daily and daily use,  $p < 0.001$  and  $p < 0.001$ , respectively), and e-cigarette use (aOR 3.45,  $p = 0.003$ ) (Table 2).

### 3.3 | CBD routes of administration and age at initiation

There were 291 past-year CBD users. The estimated median age at CBD initiation was 35 years (interquartile range: 25–46). One-third (33.5%) were the same age at the time of the study as when they initiated (i.e., had initiated <12 months prior to the study), while 35.8% initiated CBD at the same study age minus 1 year (i.e., initiated between 1 day and 24 months minus 1 day prior to the study) (Table 3).

Among past-year users, the most common route of administration was smoking (56.1%), followed by oral

administration (34.0%) and vaping (8.1%). Inhalation (vs. other routes) was more common among men, younger participants, daily tobacco smokers and electronic cigarette users (Table 3).

## 4 | DISCUSSION

From a nationwide representative sample, we estimated that almost three-quarters (71.0%) of French adults had heard of CBD, 16.4% had used it and 10.1% had used it in the previous year. Past-year CBD use was associated with younger age, having a tertiary education diploma, not living in a middle-sized urban unit, tobacco and e-cigarette use. The most common route of administration was smoking.

These figures are comparable with those published by Casanova et al. [31], based on December 2021 data. In that study, 69.2% of French adults had heard of CBD [31], while 10.1% had used it (non-null frequency of use), a rate corresponding to the past-year use we found.

Unlike Casanova et al., in the present study, we distinguished between lifetime and past-year use. The prevalence of past-year CBD use was comparable to a previous study's estimated prevalence (10.6%) for past-year cannabis use in the French adult population in 2021 [38]. Over half of the lifetime users in our study were also past-year users, and the period since initiation did not frequently exceed 2 years.

Given the relatively recent introduction of CBD to the market, follow-up studies are necessary to test for an increasing tendency in CBD awareness, and whether CBD users continue to use it over time.



The estimates of CBD awareness and CBD use in our study were higher than those reported in two German studies using representative samples; one was conducted by Alayli et al. [39] using data from 2020 to 2021, and the other by Geppert et al. using data from a similar time period [39]. With regard to the former study, the authors estimated that while half of the German population had heard of CBD, less than 5% had used it [40]. These comparatively lower figures may be related to the anteriority of their data, to the focus on CBD 'oil' in their survey, and/or to the fact that their survey targeted people aged  $\geq 14$  years. In their study, Geppert et al.'s sample included persons aged between 14 and 95 years. They reported that 40.2% of participants had heard of CBD, and 11.4% had used it [39]. Those figures are still lower than those we found for the French context. It is also possible that at the time of both the German studies, CBD had received less attention in Germany than in France, as medical cannabis has been legal there since 2017 [41]. Finally, several recent mediated legal twists and turns regarding the status of CBD in France may have increased awareness of it [42].

The relationship between younger age, tobacco use and CBD use was already highlighted by Casanova et al. [31]. Moreover, the relationship between CBD use and a higher education level, as well as tobacco and electronic cigarette use was underlined by Alayli et al. in Germany. Those authors also found a positive relationship between living in an urban area and CBD use [40]. We found similar results for living in a large urban unit (i.e.,  $\geq 200,000$  inhabitants), but also for living in a small urban unit ( $< 20,000$  inhabitants). While this positive relationship with living in a large urban unit can be explained by numerous physical CBD shops and advertising, the association with small urban units is less intuitive. One hypothesis is that people living in such areas have less access to health services [43] and therefore use CBD—purchased online or physically—as a self-medicine to treat health conditions. Indeed, self-treating medical conditions is commonly reported as a reason for using CBD [15, 44, 45], including in France [46].

This is the first study to investigate the route of CBD administration among the French general population. We found that over half of past-year users smoked it, while a third took it orally. In studies from the United States and Canada, the preponderance of smoking was not reported in non-representative samples [15, 44]. However, it does reflect findings that besides being more common among tobacco users, CBD use is also more common among cannabis users [47], including users in France [31]. This would suggest that it is smoked in the form of CBD-rich, low-THC cannabis

flowers, particularly if used as a substitute and/or a means for reducing cannabis use [47, 48].

Smoking in general is harmful and should be avoided. While solid epidemiological conclusions regarding the respiratory consequences of regular cannabis smoking are difficult to make [49], previous work indicated that cannabis smoke carries more particulate matter than tobacco smoke [30]. Therefore, adding CBD-rich cannabis to tobacco or smoking only CBD-rich cannabis (i.e., without tobacco) would likely be detrimental from a pulmonary point of view.

Our work has several implications. First, we found a high level of awareness of CBD in adults in France, and that past-year CBD use was significant in the French general population. Therefore, CBD is not a marginal issue, and proper regulation and controls are required to ensure that consumers use safe products. Second, adult users in France are likely to be young and tobacco and/or electronic cigarette users. Screening for CBD use should therefore be targeted at this population when cytochrome P450 enzymes-metabolised drugs are prescribed. Drug interactions may also occur with drugs sold over the counter such as acetaminophen (paracetamol) or ibuprofen [50]. In a US nationwide survey [51], only 25% of CBD users were concerned about interactions between CBD and their prescription drugs, and only 55.4% informed their health care professional that they were using it. In a UK-based survey, the latter figure was much lower at 29.2% [13]. Overlooking drug-interaction-related risks may be exacerbated by the representation of CBD as a safe 'natural' and/or 'alternative' medicine [13, 31]. Finally, urgent research on the consequences of smoking CBD on the pulmonary system is required, in order that reliable information can be disseminated to CBD users or potential users. Harm-reduction strategies, such as preferring smoking-free routes of administration, could also be disseminated among CBD users.

The main strength of our study is its design. By randomly selecting participants and using weighting factors, we provided nationally representative results. However, as CBD use was not its primary focus, we had limited data regarding patterns of use. Had we also collected data on CBD use frequency, doses and motivations, we would have been able to better characterise French user practices.

To conclude, our results suggest that almost three quarters of French adults have heard of CBD, and that one-10th have used it in the last year. Proper prevention, regulation and control of CBD products is required to ensure that people have access to safe and high-quality products. Moreover, reliable information on CBD needs to be disseminated, especially regarding the harms which smoking CBD can cause.

## AUTHOR CONTRIBUTIONS

Conceptualisation: Tangui Barré, Patrizia Carrieri, François Beck. Methodology: Tangui Barré, Emmanuel Lahaie, Vincent Di Beo, François Beck. Formal analysis: Vincent Di Beo. Investigation: Emmanuel Lahaie, Raphaël Andler, Viêt Nguyen-Thanh, François Beck. Writing—original draft: Tangui Barré. Writing—review and editing: all authors.

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## CONFLICT OF INTEREST STATEMENT

No conflict declared.

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