



Cannabis use in repeated representative cross-sectional studies on Italian adults after the COVID-19 pandemic

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ABSTRACT

Lockdown measures in response to the COVID-19 pandemic in 2020 yielded dramatic changes in drug consumption. A cross-sectional study was conducted on a representative sample of 6003 Italian adults (18–74 years) in April–May 2020 – reporting information before lockdown and at the time of interview – and two years later (i. e., in February–March 2022). Italian adults using cannabis decreased from 7.0% in pre-pandemic to 5.9% during lockdown (percent change -15.7%) and to 6.7% in 2022 (-4.3%). The reduction was particularly evident among adults aged 55–74 years, whereas cannabis use strongly increased among those aged 18–34 years. In the last period considered (2022), cannabis use was significantly more frequent in men (adjusted odds ratio, OR = 1.43), adults aged 18–34 years (p-trend <0.001), individuals with a low or high level of education (OR = 1.42 and 1.46, respectively), those from Central or Southern Italy/islands (OR = 1.50 and 1.38, respectively), and those with an economic status above the average (OR = 3.07). In 2022, cannabis use was also more frequently reported in current smokers (OR = 3.52), current e-cigarette and heated tobacco product users (OR = 6.09 and 2.94, respectively), individuals with a risky alcohol consumption (OR = 4.60), gamblers (OR = 3.76), those with anxiety and depression (OR = 2.50 and 2.80, respectively), those using psychotropic drugs (OR = 8.96), those with a low quality of life (OR = 1.91), and those sleeping less (OR = 1.42). After the COVID-19 pandemic, cannabis use was more frequent in individuals with other addictive behaviours, and with anxiety and depressive symptoms.

1. Introduction

In March 2020, Italy was the first country to impose a nation-wide stay-at-home order, as an attempt to curb the 2019 coronavirus disease (COVID-19) spread (Onder et al., 2020). Severe public policies – the so-called ‘lockdown’ measures – including school closures, border restrictions, and quarantine of confirmed or suspected patients, confined over 60 million individuals inside their homes for almost three months

(Odone et al., 2020a).

The pervasive impact of this mandatory lockdown promoted feelings of loneliness, hopelessness, despair in the general population, and led to marginalization and segregation (Amerio et al., 2020, 2021b). Social isolation and increased levels of depressive and anxiety symptoms, stress, and worry concerning personal health and economic consequences, impacted on individuals’ daily life with particular regard to vulnerable subgroups such as substance users (European Monitoring

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Centre for Drugs and Drug Addiction, 2021). As reported by recent studies conducted in the pandemic time, stress was confirmed to be risk factor for addictive behaviours (Avena et al., 2021). COVID-19 lockdown measures imposed by the governments of several countries in response to the 2020 pandemic yielded dramatic changes in consumption practices of drug users. Data from European countries during the first months of the pandemic showed an overall decline in drug use, or some forms of drug use (European Monitoring Centre for Drugs and Drug Addiction, 2020), confirmed by wastewater studies conducted in a number of European cities (Been et al., 2021). Reduced opportunities to use drugs within social environments, disruption of street drug markets, stock shortages, and difficulties in moving or delivering drugs, promoted a decline in the availability of some substances with consequent price increases.

With particular regard to cannabis, data from the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) referring to the first three months of the pandemic, suggest that some occasional users may have reduced or stopped cannabis use, while those who had more frequent or intensive patterns of use may have increased their consumption (European Monitoring Centre for Drugs and Drug Addiction, 2020). Subsequent studies investigating changes in cannabis use during the COVID-19 lockdown were mainly based on convenience samples (Gili et al., 2021; van Laar et al., 2020; Vidot et al., 2021; Salles et al., 2021; Bonnet et al., 2023) or focused on specific subgroups of population (i.e., adolescents, university students) (Chaffee et al., 2021; Dietz et al., 2022) or of patients (i.e., people with post-traumatic stress disorder, substance use disorder, or living with HIV) (Murkar et al., 2022; Grau-López et al., 2022; Wang et al., 2021), while data from representative samples are still scant. To date, the most consistent representative findings come from youths and adults participating in three studies from North America (Compton et al., 2023; Varin et al., 2021; Lee et al., 2023). Comparing 2018–2019 with 2020, findings from the US Population Assessment of Tobacco and Health Study revealed a decreased in cannabis use in those aged 16–17 years (from 14.9% to 7.6%), and an increased among adults aged 25 years and older (from 11.3% to 12.4%) (Compton et al., 2023), probably reflecting long-term increases among adults in the USA (Hasin and Walsh, 2021). Data from the Canadian Survey on COVID-19 and Mental Health, administered to 30,000 dwellings from September to December 2020, reported an increase in cannabis consumption since the start of the pandemic in 5.4% of respondents (Varin et al., 2021). Self-reported increases in cannabis consumption was higher for men, non-immigrants, people who reported that their income had decreased since the beginning of the pandemic, and individuals whose mental health had deteriorated. A more mixed picture emerged from the Understanding America Study, a nationally representative panel of US 8397 adults conducted in March 2020–March 2021 (Lee et al., 2023). Most participants did not regularly use cannabis (81.7%). Cannabis users increased regular use until April 2020 but then diverged: 7.1% decreased their consumption thereafter, 3.4% maintained their elevated use until October 2020 before decreasing, and the remaining 7.7% sustained their elevated use throughout.

As part of the study Lockdown and lifeSTyle IN ITALY ('Lost in Italy') (Odone et al., 2020b) and its extension 'Lost in Toscana', we assessed the effect of lockdown measures on cannabis use in a representative sample of the Italian adult population during the 'stay-at-home' weeks and after the COVID-19 lockdown. Moreover, we investigated the characteristics of cannabis users after the COVID-19 pandemic.

2. Methods

2.1. Study design and population

This analysis is based on data from the Lost in Italy study (Odone et al., 2020b) and the Lost in Toscana study. The fieldwork of both studies was conducted by Doxa, the Italian branch of the Worldwide Independent Network/Gallup International Association, and

coordinated by the Mario Negri Institute, Milan, and the Oncologic Network, Prevention and Research Institute (ISPRO), Florence, in collaboration with other Italian universities and research institutes.

The Lost in Italy study consists of a cross-sectional survey on 6003 participants who completed a web-based interview during the first Italian COVID-19 lockdown, between April 27 and May 3, 2020. The sample – representative of the Italian population aged 18–74 years in terms of age, sex, socio-economic characteristics, and geographic area – was extracted from the Doxa online panel, consisting of more than 140,000 Italian adults, including about 40,000 active individuals (i.e., participating to at least one survey in the last 12 month). Study participants were selected through a multi-stage sampling, in order to guarantee the representativeness of the Italian population: in the first phase, the municipalities in Lombardy were selected; in the second phase, for each municipality an adequate number of families were randomly selected; in the third phase, the elderly individuals to be interviewed were selected according to gender-age correlated quotas. All participants of the Lost in Italy study accepted to be re-contacted for follow-up interviews. Two years after the start of the COVID-19 pandemic, between February 24 and March 21, 2022, within the Lost in Toscana study, 6600 participants took part to a new web-based survey, conducted using a very similar protocol. This sample was also extracted from the Doxa online panel and was representative of the Italian population aged 18–74 years in terms of age, sex, socio-economic characteristics, and geographic area. Of the 6600 participants of the Lost in Toscana study, 4831 took part also into the Lost in Italy study. A sample size of 6003 individuals was chosen to obtain prevalence estimates for the factors investigated between 0.10 and 0.50 with a maximum marginal error lower between 0.01 and 0.02.

2.2. Outcome variables

In the Lost in Italy study, participants were asked to report if they used cannabis for medicinal or recreational scopes, according to two different time points: in the four weeks before the onset of the pandemic (February 2020) and during lockdown (April–May 2020). In the Lost in Toscana study, participants were asked to report their cannabis use in the previous four weeks, distinguishing between traditional cannabis and cannabis "light" (i.e., a strain of cannabis with very low level of Δ^9 -tetrahydrocannabinol (THC), legally sold in Italy). In both studies, the possible answers were: i) never; ii) 1–2 times per month; iii) approximately once per week; iv) 2–3 times per week; v) approximately every day. For the Lost in Toscana study, we defined a cannabis user as an individual who reported using either traditional cannabis or cannabis light in the previous four weeks. Frequency of use was defined as the sum of the frequencies of use of conventional cannabis and cannabis light.

2.3. Independent variables

The two studies collected information on socio-demographic characteristics such as age, sex, level of education, economic status, marital status, and geographic area (i.e., northern, central and southern Italy). A specific section of the study questionnaires was focused on selected addictive behaviours. Participants reported their smoking status, use of electronic cigarettes (e-cigarettes) and heated tobacco products (HTP), if they were at risk of alcohol use disorder (according to the Alcohol Use Disorders Identification Test, AUDIT-C, scale) (Saunders et al., 1993), and their gambling habits. A specific section of the questionnaire was focused on mental health outcomes. Information on sleep quality was obtained through the question: "How would you rate your sleep quality overall?" (item #9 from the Italian version of the Pittsburgh Sleep Quality Index, PSQI); sleep quantity was assessed in hours of sleep per night as a continuous measure (integer number), using the question: "How many hours of actual sleep did you get at night?" (PSQI item #4) (Buysse et al., 1989; Curcio et al., 2013). Anxiety symptoms and

depressive symptoms were investigated using the short versions of the Generalized Anxiety Disorder (GAD-2) and Patient Health Questionnaire (PHQ-2) scales (Kroenke et al., 2003, 2007; Mazzotti et al., 2003). A score of GAD-2 ≥ 3 indicated the presence of anxiety symptoms and a score of PHQ-2 ≥ 3 indicated the presence of depressive symptoms (Staples et al., 2019). Quality of life was assessed using the Visual Analogue Scale (Robinson et al., 2001). A final section was dedicated to the use of selected psychotropic drugs (antidepressants, anxiolytics/benzodiazepines, hypnotics, antipsychotics, mood stabilizers).

2.4. Statistical analysis

Cannabis use and intensity of use were assessed in three different time points, i.e., February 2020, April–May 2020, and February–March 2022. We used unconditional multiple logistic regression models to estimate odds ratios (OR), and corresponding 95% confidence intervals (CI), of cannabis use in 2022 according to various individuals' characteristics. All models were adjusted for selected socio-demographic variables, i.e., sex, age, level of education, and geographic area. In both Lost in Italy and Lost in Toscana datasets, a statistical weight was applied to all the analyses to guarantee the representativeness of the national sample in terms of sex, age, socio-economic status, and geographic area. All statistical analyses were performed using the software SAS, version 9.4 (Cary, North Carolina, USA).

2.5. Ethics

Both the Lost in Italy and Lost in Toscana surveys were carried out in accordance with the Declaration of Helsinki. The studies received approval from local ethics committees (Istituto Besta, file number: 71–73, April 2020, and Comitato Etico Regionale per la Sperimentazione Clinica della Toscana, Ssezione Area Vasta Centro, file number: CEAVC, 19834, April 2021, respectively). All participants provided an informed consent to participate to the study.

3. Results

Overall, the proportion of individuals using cannabis before the onset of the COVID-19 pandemic was 7.0% (Table 1). This proportion declined to 5.9% (percent change -15.7%) during the lockdown and increased from 5.9% to 6.7% ($+13.6\%$) in the following two years. In 2022, compared to before the start of the pandemic, the proportion of Italian adults using cannabis was decreased from 7% to 6.7% (-4.3%). The main changes during the lockdown were observed particularly among occasional users: the proportion of individuals using cannabis 1–2 times per month decreased from 2.8% to 1.8% (-35.7%) during lockdown compared to before, whereas the proportion of individuals using cannabis every day remained stable over the same period (0.7% at both time points). Two years from the start of the COVID-19 pandemic

Table 1

Distribution of Italian adults aged 18–74 years according to cannabis use before the COVID-19 lockdown (February 2020), during the COVID-19 lockdown (April–May 2020), and two years later (February–March 2022).

	Pre-lockdown (February 2020)	During- lockdown (April–May 2020)	February–March 2022
Total (N)	6003	6003	6600
Cannabis users (%)	7.0	5.9	6.7
Frequency of use (%)			
1–2 times/month	2.8	1.8	2.7
Approximately once per week	2.2	2.4	2.3
2–3 times/week	1.3	1.1	1.1
Approximately every day	0.7	0.7	0.6

compared to before, the proportion of individuals using cannabis 2–3 times per week decreased from 1.3% to 1.1% (-15.4%), and that of those using cannabis approximately every day decreased from 0.7% to 0.6% (-14.3%).

Fig. 1 shows the proportion of Italian adults using cannabis before the COVID-19 lockdown (February 2020), during the COVID-19 lockdown (April–May 2020), and two years later (February–March 2022) overall, and by sex and age group. The patterns in cannabis use over the three time periods was similar in men and women. However, two years after the start of the pandemic the proportion of cannabis users strongly increased from 12.9% to 16.4% (percent change $+27.1\%$), among individuals aged 18–34 years compared to before the onset of the pandemic. The distribution of type of cannabis use (traditional, light or both) in 2022 overall, and by sex and age group is given in Supplementary Fig. 1.

In 2022, cannabis use was more frequent in men (OR 1.43; 95% CI 1.17–1.75, as compared to women), individuals with a low level of education (OR 1.42; 95% CI 1.05–1.92) or high level of education (OR 1.46; 95% CI 1.17–1.81, compared to those in the intermediate level), individuals from central Italy (OR 1.50; 95% CI 1.17–1.91) or southern Italy and islands (OR 1.38; 95% CI 1.09–1.75, compared to those from northern Italy), and individuals with an economic status above the national mean (OR 3.07; 95% CI 2.42–1.75, as compared to those with an average economic status; Table 2). Conversely, cannabis use was less frequently reported among older individuals (OR 0.09; 95% CI 0.07–0.13, compared to younger ones; p for trend <0.001) and single individuals (OR 0.74; 95% CI 0.59–0.94, compared to married ones).

Cannabis use was more frequently reported in former (OR 1.98; 95% CI 1.51–2.61) and current smokers (OR 3.52; 95% CI 2.78–4.46, compared to never smokers), in past (OR 9.20; 95% CI 7.17–11.8) and current e-cigarette users (OR 6.09; 95% CI 4.42–8.39, compared to never users), and in past (OR 5.25; 95% CI 4.18–6.58) and current HTP users (OR 2.94; 95% CI 2.11–4.08, compared to never users; Table 3). Cannabis use was also more frequently reported among individuals with an alcohol behaviour at risk (OR 4.60; 95% CI 3.73–5.67) and in gamblers (OR 3.76; 95% CI 3.04–4.65).

With reference to selected mental health characteristics, cannabis use was more frequent among individuals using psychotropic drugs (OR 8.96; 95% CI 7.01–11.5), individuals with anxiety (OR 2.50; 95% CI 2.04–3.07) or depressive symptoms (OR 2.80; 95% CI 2.27–3.46), in individuals reporting a low quality of life (OR 1.91; 95% CI 1.52–2.40), and those sleeping less than 7 h per night (OR 1.42; 95% CI 1.16–1.74; Table 4). Further adjustment for tobacco smoking and alcohol drinking did not meaningfully modify the associations observed (data not shown).

4. Discussion

During the COVID-19 lockdown, cannabis use was reduced by 16%, with the main changes among occasional users. In 2022, compared to pre-pandemic time, the proportion of Italian adults using cannabis decreased by 4.3%; the reduction was particularly evident among adults aged 55–74 years, whereas cannabis use strongly increased among those aged 18–34 years. In 2022, cannabis use was more frequent in men, individuals with a low or high level of education, individuals from central or southern Italy and islands, individuals with a higher economic status, individuals with other addictive behaviours, and those with anxiety and depressive symptoms. Conversely, cannabis use was less frequently reported among older and single individuals.

Our findings that cannabis use declined during the lockdown among occasional Italian users, but remained stable among those with a more chronic pattern of use, confirms data from the EMCDDA reporting a decrease in cannabis use during the first months of the COVID-19 pandemic among occasional users (European Monitoring Centre for Drugs and Drug Addiction, 2020), as well as with the results from a nationally representative US sample, despite the laxer lockdowns

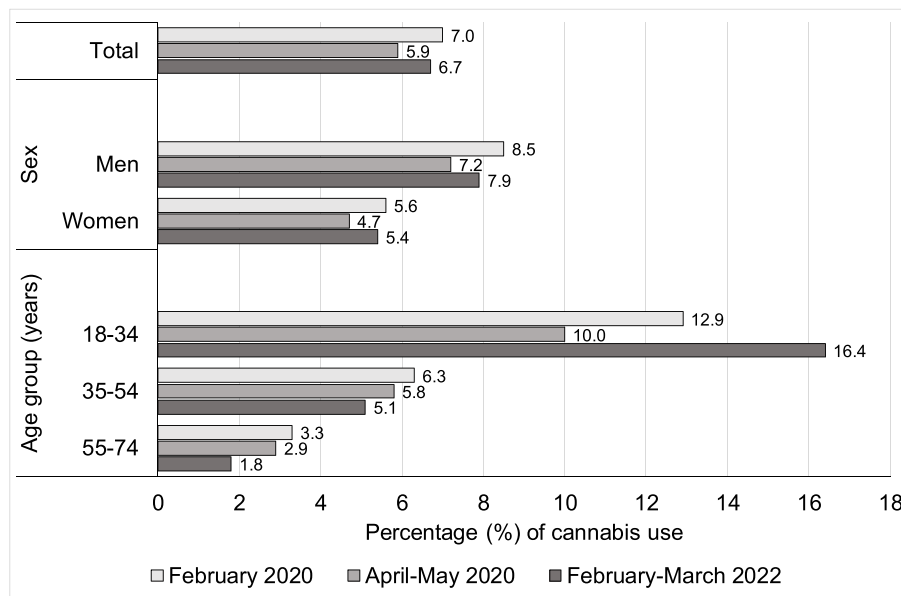


Fig. 1. Distribution of Italian adults aged 18–74 years according to cannabis use before the COVID-19 lockdown (February 2020), during the COVID-19 lockdown (April–May 2020), and two years later (February–March 2022), overall, and by sex and age group.

Table 2
Distribution of 6600 Italian adults aged 18–74 years according to cannabis use in 2022 by selected socio-demographic characteristics.

	N. individuals	Individuals using cannabis (%)	OR for cannabis use (95% CI) *
Sex			
Women	3331	5.4	1.00°
Men	3269	7.9	1.43 (1.17–1.75)
Age group (years)			
18–34	1597	16.4	1.00°
35–54	2687	5.1	0.27 (0.22–0.33)
55–74	2316	1.8	0.09 (0.07–0.13)
P for trend			<0.001
Level of education			
Low	992	6.6	1.42 (1.05–1.92)
Intermediate	3337	5.6	1.00°
High	2271	8.3	1.46 (1.17–1.81)
P for trend			0.15
Geographic area			
Northern Italy	3285	5.6	1.00°
Central Italy	1587	7.8	1.50 (1.17–1.91)
Southern Italy and Islands	1728	7.7	1.38 (1.09–1.75)
Marital status			
Married	4496	6.0	1.00°
Divorced/separated	449	5.5	1.41 (0.91–2.20)
Widowed	152	2.0	0.58 (0.18–1.89)
Single	1503	9.4	0.74 (0.59–0.94)
Economic status			
Above the Italian mean	992	14.5	3.07 (2.42–3.90)
On average	3982	5.5	1.00°
Below the Italian mean	1627	4.7	0.90 (0.68–1.19)
P for trend			<0.001

CI: confidence interval; OR: odds ratio.

* Estimated by unconditional multiple logistic regression models after adjustment for sex, age, level of education, and geographic area; estimates in bold type are statistically significant at 0.05 level.

° Reference category.

observed in that country (Lee et al., 2023). Because of strict restrictions on movement, people were not allowed to travel outside a limited radius from their residence, which may have impeded the purchasing of

Table 3
Distribution of 6600 Italian adults aged 18–74 years according to cannabis use in 2022 by selected addictive behaviours habits.

	N. individuals	Individuals using cannabis (%)	OR for cannabis use (95% CI) *
Smoking status			
Never	3270	4.3	1.00°
Former	1721	5.9	1.98 (1.51–2.61)
Current	1609	12.2	3.52 (2.78–4.46)
E-cigarette use			
Never	4696	2.0	1.00°
Past	1308	20.2	9.20 (7.17–11.8)
Current	596	13.4	6.09 (4.42–8.39)
HTP use			
Never	5337	3.8	1.00°
Past	823	22.2	5.25 (4.18–6.58)
Current	439	12.3	2.94 (2.11–4.08)
Alcohol consumption			
Not at risk	4626	3.6	1.00°
At risk	1974	13.8	4.60 (3.73–5.67)
Gambling			
No	5287	4.2	1.00°
Yes	1313	16.4	3.76 (3.04–4.65)

CI: confidence interval; HTP: heated tobacco products; OR: odds ratio.

* Estimated by unconditional multiple logistic regression models after adjustment for sex, age, level of education and geographic area; estimates in bold type are statistically significant at 0.05 level.

° Reference category.

cannabis in occasional users, with less contacts with drug dealers and less used to home-growing, compared to those who had more frequent or intensive patterns of use.

Conversely to the decrease in cannabis use observed in adults aged 50 or more, an increase in cannabis use was found in younger adults aged 18–34 years. Psychological response following exposure to various stressful events is extremely heterogeneous. People can show a high degree of resilience and quickly return to normal lives or develop different kind and degree of psychiatric symptoms. University education is a crucial period in a transitional age, between adolescence and adulthood, because of higher distress that students are exposed to compared to the general population (Arnett et al., 2014). Emancipation, financial self-sufficiency, career’s choices, intimate and friendship

Table 4
Distribution of 6600 Italian adults aged 18–74 years according to cannabis use in 2022 by selected mental health characteristics.

	N. individuals	Individuals using cannabis (%)	OR for cannabis use (95% CI) *
Use of psychotropic drugs			
No	6024	4.8	1.00°
Yes	576	26.2	8.96 (7.01–11.5)
Quality of life			
Low	1253	10.1	1.91 (1.52–2.40)
High	5348	5.9	1.00°
Sleep quantity (hours/night)			
<7	2995	7.1	1.42 (1.16–1.74)
≥7	3605	6.3	1.00°
Sleep quality			
Low	1843	6.4	1.00°
High	4758	6.8	1.04 (0.83–1.32)
Anxiety symptoms			
No	4764	4.5	1.00°
Yes	1836	12.2	2.50 (2.04–3.07)
Depression symptoms			
No	5308	4.9	1.00°
Yes	1292	14.0	2.80 (2.27–3.46)

CI: confidence interval; OR: odds ratio.

* Estimated by unconditional multiple logistic regression models after adjustment for sex, age, level of education and geographic area; estimates in bold type are statistically significant at 0.05 level.

° Reference category.

relationship are just some of the challenges that undergraduate students are faced with. In the COVID-19 context, prolonged university closures and social distancing-imposed measures obliged students to at-home learning with online lectures and educational programs promoting potential social isolation, loneliness, hopelessness, and episodes of clinical decompensation (Amerio et al., 2021a). Probably, the relief of both boredom and post-traumatic symptoms could explain the reasons for the increased use of cannabis we found in youths (European Monitoring Centre for Drugs and Drug Addiction, 2020; Chong et al., 2022).

Findings from our study confirmed cannabis as being a very commonly used illicit drug, mostly consumed by young men compared to older individuals, and well distributed in all segments of the population (European Monitoring Centre for Drugs and Drug Addiction, 2019). With particular regard to the Italian situation, in line with the Report of the Central Directorate for Antidrug Services that annually provide a summary of the status and trend of the drug trafficking in Italy, individuals from Central or Southern Italy and islands reported a higher cannabis use compared to the other regions (Central Directorate for Antidrug Services, 2021).

Cannabis use was found to be more frequent in current smokers, e-cigarette and HTP users. As recently reported (Weinberger et al., 2020), the use of both tobacco and cannabis may be driven by common individual, social, and environmental risk factors as well as shared genetic vulnerabilities. From a neurobiological point of view, systems involved with nicotine and cannabis (i.e., the nicotinic and endocannabinoid systems) overlap and the exposure to nicotine seems to trigger changes in the central nervous system leading to a stronger response to cannabis (Volkow et al., 2014). Moreover, behavioural mechanisms as hand-mouth movements, puffing, inhalation and exhalation, among others, could contribute to make the transition from one another a more natural process, and help to understand the relationship between the use of e-cigarettes, HTPs, conventional tobacco and cannabis use (Sangster-Carrasco and Blitchtein-Winicki, 2022).

Cannabis use was more frequent among gamblers. As confirmed by the scientific literature (Lee et al., 2014), cannabis use frequently co-occurs with gambling, and both acute and chronic use may influence gambling behaviour. In adolescents and young adults, the co-occurrence of cannabis use is frequently associated with earlier age of gambling onset, more hours spent gambling, non-skill gambling (e.g., electronic

gambling machines), and using other substances while gambling. A similar picture emerges among adults where the co-occurrence of cannabis lead to greater problem gambling severity (Punia et al., 2021). Cannabis is the most common substance used by adolescents and young adults who drink alcohol (Subbaraman et al., 2017).

Cannabis use was also more frequent among individuals with a risky alcohol behaviour. Evidence from the literature suggest that cannabis use is associated with both heavy drinking and with the development and maintenance of alcohol use disorders (Blanco et al., 2016). Interesting results came from studies that analyse the association between frequency of cannabis use and reported alcohol-associated adverse effects (Ramadan et al., 2020). Data indicates that not only frequent cannabis users, but even those who use cannabis less frequently, are more likely to report alcohol-associated adverse effects compared to those who report no lifetime cannabis use.

Findings from our study showed that cannabis use is more frequent among individuals with anxiety and depressive symptoms or using psychotropic drugs. Individuals with anxiety (especially social anxiety) and depression have been reported to be at increasing risk of cannabis use, with a particularly strong increase in daily or near-daily cannabis use (Buckner and Zvolensky, 2014; Gorfinkel et al., 2020). The association between cannabis and depression could lead to different interpretations (Feingold and Weinstein, 2021). To date, there is some evidence that the use of cannabis may lead to the onset of depression (Lev-Ran et al., 2014). However, strong evidence points that depression may lead to the onset or increase in cannabis use frequency (Feingold et al., 2015; Gruber et al., 1997; Osborne et al., 2000). No positive long-term effect of cannabis use has been reported on the course and outcome of depression. With reference to anxiety, cannabis can also lead to euphoria accompanied by a decrease in anxiety and an increase in sociability, or produce feelings of anxiety, panic, paranoia and psychosis (Sharpe et al., 2020). THC has been associated with an anxiogenic response, while anxiolytic activity has been attributed mainly to cannabidiol. However, recent publications have shown that this outcome of THC is dosage-dependent, with lower dosages having the opposite effect.

Among the limitations of the present study, there are those inherent to its cross-sectional design which do not allow to make any inferences of causal associations. However, our surveys have the strength to be based on large samples. Despite the efforts implemented to obtain a representative sample, the selection of the sample from an online panel could compromise the generalizability of the findings to the whole Italian adult population. Moreover, within the survey we investigated various individuals' characteristics, measured through valid scales. Data were collected through online surveys, proved to be an effective tool for overcoming social-distancing measures during the COVID-19 pandemic (Hlatshwako et al., 2021).

Our findings provide an evaluation of the impact of nation-wide lockdown measures on cannabis use in the general population during the 'stay-at-home' weeks and after the COVID-19 lockdown and suggest how determinants and mediators of cannabis use are to be explored beyond imposed social distancing, into behavioural, environmental, social, and other determinants. Further studies are needed to fill the gap in our understanding around the cause-and-effect relationship between cannabis use and individual and environmental factors in order to plan and implement appropriate and targeted interventions centred on vulnerable population health.

Authors' contribution

AA: manuscript drafting, funding; CS: statistical analysis; CB: analysis and interpretation of data, manuscript drafting; GC: study concept and design, funding; TF: manuscript drafting; GG: study concept and design, funding; AL: study supervision, RP: study concept and design, funding; GS: funding; AO: study concept and design, funding; SG: study concept and design.

All authors had full access to the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. They all revised the final manuscript.

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Availability of data and materials

Data that support the findings of this study and materials are available from the corresponding author upon request.

Ethical standards

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000.

Declaration of competing interest

Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpsychires.2023.06.041>.

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