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Correlates of the use of electronic devices to vape cannabis in a cohort of young Swiss male reporting current cannabis use.

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Abstract:

Background: Information about correlates of cannabis vaping in Europe is scarce.

Methods: In a cohort of 1,613 Swiss young males currently using cannabis, we used logistic regression, adjusting for age, linguistic region and education to assess the association between sensation seeking, substance use and sociodemographic variables with cannabis vaping.

Results: Mean age was 25.38 years, 60.4% had post-secondary education and 57.3% lived in French-speaking cantons; 26.3% met criteria for nicotine dependence, 16.0% met criteria for alcohol use disorder, and 34.9% used illicit drugs other than cannabis; 27.4% used cannabis at least twice a week and 27.8% met criteria for cannabis use disorder (CUD). Ninety-four participants (5.8%) reported cannabis vaping (of them 87.4% reported infrequent cannabis vaping)

In the adjusted analysis, using joints with no tobacco [adjusted OR (aOR) (95% CI)=1.45 (1.02-1.76)], water pipe with [aOR (95% CI)=1.70 (1.29-2.24)] and without tobacco [aOR (95% CI)=2.15 (1.60-2.87)], cannabis mixed with food [aOR (95% CI)=1.61 (1.29-2.02)], using cannabis >2 times a week [aOR (95% CI)=3.73 (2.40-5.81)], meeting criteria for CUD [aOR (95% CI)=4.19 (2.70-6.50)], using illicit drugs other than cannabis [aOR (95% CI)=1.88 (1.23-2.87)], weekly number of alcohol drinks [aOR (95% CI)=1.01 (1.00-1.03)]and living in the German-speaking area of Switzerland [aOR (95% CI)=2.70 (1.71-4.25)] were associated with higher odds of cannabis vaping; post secondary schooling [aOR (95% CI)=0.37 (0.16-0.86)] and vocational training [aOR (95% CI)=0.41 (0.17-0.99)] (as opposed to primary schooling) were associated with lower odds of cannabis vaping.

Conclusion: Cannabis vaping might be a marker of riskier behaviors among cannabis users.

Introduction:

Electronic cigarettes (e-cigarettes) are nicotine delivery devices for humans that have been studied as a harm-reduction strategy to decrease the use of combustible cigarettes [1], [2]. The prevalence of use of e-cigarettes is increasing in Western countries, and the use of flavoring products seems to be very appealing for adolescents and young adults [3, 4]. Besides the increased exposure to nicotine that can lead to nicotine addiction, e-cigarette use is also potentially harmful in the form of lung injury [5].

There is also concern around the use of e-cigarettes to smoke cannabis and their derived products, like cannabidiol and butane hash oils (BHO), a cannabis concentrate with higher potency than marijuana [6]. Despite that earlier reports indicated that e-cigarettes seemed to be an unappealing method for cannabis use [7], cannabis vaping has become an increasingly popular method of cannabis use [8], [9]. In a US study among the general population, 7.6% of those using cannabis reporting the use of a vaporizer or another electronic device to consume cannabis [10], and in a high school sample in the year 2017, 9.6% of all high school students reported ever vaping cannabis [11]. In addition, recent vaping-related injuries and deaths in the US have been attributed to cannabis products [5], [12].

Cannabis is the most commonly used illicit substance in the United States and in Europe [13], [14], and the prevalence of cannabis use is increasing in young adults [13], what has also been reported in Switzerland [15]. The changing legal status of cannabis use and an increasing availability of vaping devices seem to be the driving force for the increase of cannabis vaping seen in recent years [9], [16].

Very few studies have described correlates of vaping cannabis, and the majority have been performed in the US [17], [18], [19, 20]. In those studies, several factors, like male sex, younger age, impulsivity, and alcohol or other drug use were associated with higher odds of vaping cannabis

[17], [18], [19], [20]. We are not aware of any study that has assessed correlates of cannabis vaping in Europe where cannabis use is still illegal.

In the present study we wanted to describe cannabis vaping among participants in the Cohort Study on Substance Use Risk Factors (C-SURF), from Switzerland. In addition, we wanted to describe what clinical and drug use characteristics were associated with the use of electronic devices to vape cannabis.

Methods:

Study aim: We wanted to describe correlates of cannabis vaping in a cohort of Swiss young males currently reporting cannabis use.

Study design and participants:

Data for the present study was drawn from the third wave of the Cohort Study on Substance Use Risk Factors (C-SURF), a longitudinal study designed to investigate the use of alcohol, tobacco, cannabis and other substance use in emerging adulthood in Switzerland.
The research protocol (15/07) was approved by the Cantonal ethics committee (Commission cantonale d'éthique de la recherche sur l'être humain, CER-VD). Enrolment took place between August 2010 and November 2011 in three of the six army recruitment centers, covering 21 of the 26 Swiss cantons. As army recruitment is mandatory for 19-year-old males in Switzerland, virtually all were eligible for participation in the cohort [21]. The C-SURF study covers all French-speaking cantons and a wide range of German-speaking cantons. At enrolment, 7,556 young men gave written consent to participate to the study and 6'528 participated in any of the three waves. Among them, 5,516 (73.0% response rate of consenters) completed the third wave questionnaire between April 2016 and March 2018, when they were 25.45 years old, on average. Questionnaires were completed at home,

independent of army procedures. Assessments were not done during recruitment and no information was provided to the army. The English speaking version of the C-SURF questionnaire is freely accessible on the C-SURF webpage (https://www.c-surf.ch/img/questionnaires_pdf/q3_follow_up2_en.pdf)

For the present study we selected those C-SURF participants who reported cannabis use in the previous 12 months at wave 3 (6 years after army recruitment). A total of 1,670 participants reported cannabis use. Participants with missing values on variables of interest (N = 57, 3.4%) were excluded. The final sample for analysis comprised 1,613 participants.

Measurements:

Cannabis vaping. Cannabis vaping was measured by a yes / no question asking participants whether or not they have used, even rarely, e-cigarettes to vape cannabis. The question was adapted from a prior study by Etter[7] and it was only asked to those reporting having used illegal cannabis in the previous 12 months. The question read as follows: *Do you use, even rarely, e-cigarettes to vape illegal cannabis?*

This variable was used as criterion variable in the analyses. Those reporting vaping cannabis were also asked how often they use e-cigarettes to vape cannabis. This variable was recoded to differentiate between infrequent ("seldom", "sometime") and frequent ("often", "always") cannabis vaping and used for descriptive purpose. Those reporting vaping cannabis were also asked what cannabis products they have used in their e-cigarette using four yes / no questions: 1. Flowers of cannabis, 2. Haschisch, 3. Cannabis oil, and 4. WAX / BHO.

Cannabis use. Cannabis use frequency was measured by asking participants how often they usually used cannabis in the previous 12 months. It was dichotomized to reflect less than twice a week and at least twice a week use. Frequency of use of different routes of administration of cannabis was also measured: 1. Joint of cannabis with tobacco, 2. Joint of cannabis without

tobacco, 3. Water pipe with tobacco, 4. Water pipe without tobacco, 5. Cannabis mixed with food. Participants were asked to report how often they used each route of administration on a five-point scale ranging from 1-never to 5-always. Cannabis use disorder (CUD) was measured using the Cannabis Use Disorder Identification Test (CUDIT) [22]. This is a ten-item tool asking about the presence of symptoms of CUD during the previous twelve months and yielding a score ranging from 0 to 40. According to the authors, CUD was defined as scores of eight or above.

Alcohol use. Quantity-frequency measures were used to evaluate the previous 12 months usual number of standard drinks during weekends and weekdays separately. Weekly number of standard drinks was obtained by summing number of drinks during weekend and weekdays. Frequency of binge drinking (i.e. drinking 6 or more standard drinks on a single occasion) was also measured and coded "never", "less than once a month" and "once a month or more often". Measure of alcohol use disorder (AUD) was based on the eleven criteria of the fifth edition of the diagnostic and statistical manual of mental disorders [23]. Questions were taken from Knight et al. [24] plus an additional criterion for craving. AUD was defined as scores of 4 or above corresponding to moderate or more severe AUD according DSM-5.

Cigarette use. Frequency of cigarette smoking in the previous 12 months was measured to differentiate between non-, occasional, and daily smokers. Nicotine dependence was assessed using the Fagerström Test for Nicotine Dependence [25] . Based on the continuous score ranging from 0 to 10, nicotine dependence was defined as scores of 3 or more [26].

Use of illicit drugs other than cannabis. Participants were asked whether they had used 18 different illicit drugs other than cannabis (e.g. cocaine, ecstasy, hallucinogens) in the previous 12 months. A variable reflecting use of any drugs other than cannabis was created.

Sensation seeking. The Brief Sensation Seeking Scale [27] was used. Participants were asked to what extent they agreed with eight statements on a five-point scale. The score consists of the average of all eight items.

Sociodemographics. Sociodemographic variables included age, linguistic region (French-, German-speaking), and highest completed level of education (i.e. primary schooling, vocational training, post-secondary schooling).

Statistical analysis:

Descriptive statistics were expressed as the mean, and standard deviation (SD) for quantitative variables, or as absolute frequencies and percentages for qualitative variables.

Substance use variables, sociodemographic variables, and sensation seeking were used to test their association with cannabis vaping as outcome using logistic regression. Unadjusted (bivariate) and adjusted (for sociodemographic variables) models were tested. Test results were considered statistically significant if the resulting two-tailed p value was < 0.05. Statistical analysis was performed using SPSS 25 software (Armonk, NY).

Results:

Among the 1,613 participants using cannabis in the past 12 months, 94 (5.8%) used electronic devices to vape cannabis. The majority of participants who used electronic devices to vape cannabis (90.5%) did so with flowers of cannabis, 23.2% with cannabis oil, 21.1% with hashish and 9.5% with wax or BHO. Cannabis vaping occurred infrequently (seldom or sometimes) in 87.4%, while 12.6% reported more frequent cannabis use with electronic cigarettes.

The main characteristics of the study population, stratified by the use of an electronic device to vape cannabis are shown in Table 1.

In brief, the mean age was 25.38 years, 60.4% had post-secondary education and 57.3% lived in French-speaking cantons. In terms of substance use, a majority of participants (72.6%) were occasional or daily tobacco smokers, 26.3% met criteria for nicotine dependence, only 8.2% reported no binge drinking, 16.0% met criteria for alcohol use disorder, and 34.9% reported use of illicit drugs other than cannabis. In terms of cannabis used, 27.4% used cannabis at least twice a week and 27.8% met criteria for cannabis use disorder.

Table 2 shows the unadjusted and adjusted logistic associations with cannabis vaping. In both unadjusted and adjusted logistic regression models, there were several substance use and socio-demographic characteristics associated with cannabis vaping. Among those, using cannabis twice a week or more (versus less often), using "joints" with no tobacco, using a water pipe with and without tobacco, eating food with cannabis, meeting cannabis use disorder criteria, using illicit drugs other than cannabis, and living in a German (vs. French-)-speaking area of Switzerland were significantly and positively associated with the use of an electronic device to vape cannabis. In addition, in the adjusted analyses, weekly number of standard drinks was significantly and positively, whereas vocational training and post-

secondary schooling (vs. primary schooling) were significantly and negatively associated with

cannabis vaping. Of note, sensation seeking, a measure of impulsivity was not associated with

cannabis vaping.

Discussion:

In this study of young Swiss male with current cannabis use, cannabis vaping was infrequent and it was associated with use of cannabis at least twice a week, modes of cannabis administration other than joints with tobacco, meeting criteria for cannabis use disorder, the use of illegal drugs other than cannabis, weekly standard drinks and living in a German speaking area of Switzerland. Of note, having an education higher than primary schooling was associated with lower odds of vaping cannabis. Therefore, cannabis vaping in this cohort is a marker of a constellation of risky behaviors, like the consumption of higher quantities of alcohol or other illegal drugs and with the intensity of cannabis use or the presence of cannabis use disorder. In view of these results, vaping cannabis should be not perceived as innocuous by public health authorities. In fact, in a prior study by Baggio and colleagues [28] showed that diversification in routes of cannabis administration can be associated with heavier illicit drug use.

The fact that cannabis is still illegal in Switzerland might partially account for the low prevalence of cannabis vaping, in comparison to studies performed in the U. S. [10]. Because of its illegal status, people may also underreport cannabis use. Similarly, because of its illegal status, availability of cannabis vaping products is low compared to countries like the U.S. or Canada.

In countries where cannabis is legal, several legal aspects have been associated with vaping cannabis. In a Facebook survey of young people reporting cannabis use, duration of legal cannabis laws (OR= 2.82) and higher density of venues where cannabis is dispensed (OR= 2.86) were associated with cannabis vaping [29]. In another study, the existence of laws for recreational cannabis use and less restrictive cannabis policies were also exposure variables for a higher prevalence of cannabis vaping [12, 17].

Besides legal aspects, male gender and daily herbal cannabis use were associated with vaping cannabis [17]. Consistent with our results, in a cross-sectional study in the 2017 North Carolina

Youth Tobacco Survey, adolescents who reported using cigars, water pipe or e-cigarette higher odds of ever vaping cannabis [11].

Participants in other studies also reported that vaping cannabis was more convenient than smoking cannabis and that the use of an e-cigarette made cannabis easier to conceal or hide [19].

The association between alcohol use and cannabis vaping has also been reported by Frohe and colleagues in a study of college students in the US [18]. In that study, alcohol use was measured in drinks per drinking day [18], and in the present study we obtained the weekly number of drinks after computing the number of drinks on drinking days and the usual frequency.

We are not aware of other studies that have assessed the impact of drugs other than cannabis and cannabis vaping. In our study the association between the use of other drugs and cannabis vaping and the protective effect of attaining a degree higher than primary schooling speak to the fact that cannabis vaping in the C-SURF cohort is associated with exposures associated with riskier behaviours.

Other researchers have found that impulsivity and poor self control, as well as initiating the use of e-cigarettes are at earlier stage were also predictors of cannabis vaping [19]. In the current study, impulsivity and poor self-control were not assessed. We assessed another disinhibition trait than impulsivity, namely sensation seeking. Sensation seeking was not significantly associated with cannabis vaporization. Although impulsivity and sensation seeking are two measures of disinhibition, these two dimension appear to have different effect on alcohol use [30]. This could be similar for cannabis vaporization.

The association between living in German-speaking cantons and vaping cannabis is surprising. Given that no differences exist regarding the legal status of cannabis between linguistic regions, those differences might be due to different patterns of cannabis use or of self-reporting or due to different perceptions of risk or access to vaping products. In addition, we

cannot exclude that those differences are due to unmeasured confounding around cultural approaches to cannabis use or to socioeconomic differences between linguistic regions.

An important strength of the present study is that it is based on a large sample of young Swiss male that are currently using cannabis.

On the other hand, the present study has limitations that have to be noted. First, the sample is all male and responses are based on self-reported measures. Second, given the cross-sectional nature of the data, we are not able to make strong inferences about causality or the timing of risk factors. Third, the results observed in the study may not be generalized to areas where the use of cannabis is legal.

In conclusion, cannabis vaping can be a marker of risk in young adults that use cannabis, as it is associated with using joints with no tobacco and meeting criteria for cannabis use disorder, as well as with the weekly number of standard drinks and with the use of illicit drugs other than cannabis.

Conflict of interest: None declared.

Keypoints:

- In this cohort of Swiss male who reported cannabis use the use of electronic cigarettes was uncommon.

- Cannabis vaping was associated with using joints with no tobacco, water pipe with and without tobacco, cannabis mixed with food, using cannabis >2 times a week, meeting criteria for Cannabis Use Disorder, using illicit drugs other than cannabis, weekly number of alcohol drinks and living in the German-speaking area of Switzerland.

- Cannabis vaping might be a marker of riskier behaviors among cannabis users.

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Table 1. Clinical and socio-demographic characteristics of the 1,613 young Swiss males currently using cannabis, stratified by the use of electronic devices to vape cannabis.

Variable	Use of electronic devices to vape cannabis		Total study population (N=1613)
	Yes (N=94)	No (N=1519)	
	N (%)	N (%)	N (%)
Age [mean (SD)]	25.34 (1.11)	25.39 (1.21)	25.38 (1.20)
Education:			
• Primary schooling	7 (7.4)	56 (3.7)	63 (3.9)
• Vocational training	36 (38.3)	540 (35.5)	576 (35.7)
• Post-secondary schooling	51 (54.3)	923 (60.8)	974 (60.4)
Linguistic region:			
• French	34 (36.2)	891 (58.7)	925 (57.3)
• German	60 (63.8)	628 (41.3)	688 (42.7)
Smoking status			
• Non smoker	30 (31.9)	412 (27.1)	442 (27.4)
• Occasional smoker	27 (28.7)	550 (36.2)	577 (35.8)
• Daily smoker	37 (39.4)	557 (36.7)	594 (36.8)
Nicotine dependence	28 (29.8)	396 (26.1)	424 (26.3)
Alcohol use disorder	21 (22.3)	237 (15.6)	258 (16.0)
Binge drinking			
• Never	8 (8.5)	125 (8.2)	133 (8.2)
• Less than once a month	32 (34.0)	516 (34.0)	548 (34.0)
• Once a month or more	54 (57.4)	878 (57.8)	932 (57.8)
Weekly number of standard drinks [mean (SD)]	12.87 (15.03)	10.79 (11.08)	10.91 (11.35)
Use of illicit drugs other than cannabis	45 (47.9)	518 (34.1)	563 (34.9)
Cannabis status:			
• Less than twice a week	43 (45.7)	1128 (74.3)	1171 (72.6)
• At least twice a week	51 (54.3)	391 (25.7)	442 (27.4)
Modes of administration of cannabis:			
• Joints with no tobacco [mean (SD)]	1.91 (1.07)	1.54 (0.88)	1.57 (0.89)
• Joints with tobacco [mean (SD)]	3.86 (1.33)	4.08 (1.20)	4.07 (1.21)
• Water pipe with tobacco [mean (SD)]	1.39 (0.79)	1.15 (0.48)	1.16 (0.51)
• Water pipe with no tobacco [mean (SD)]	1.45 (0.77)	1.14 (0.45)	1.16 (0.48)
• Food [mean (SD)]	1.86 (0.74)	1.47 (0.72)	1.49 (0.73)
Cannabis use disorder	55 (58.5)	394 (25.9)	449 (27.8)
Sensation seeking [mean (SD)]	3.41 (0.79)	3.36 (0.71)	3.36 (0.72)

Table 2. Correlates of cannabis vaping among 1,613 young Swiss male currently using cannabis.

Variable	Unadjusted OR	Unadjusted 95% CI	Adjusted[a] OR	Adjusted[a] 95% CI
Age	0.97	0.81, 1.16	1.06	0.88, 1.27
Education:				
• Primary schooling	1		1	
• Vocational training		0.23, 1.25	0.41	0.17, 0.99
• Post-secondary schooling	0.53	0.19, 1.02	0.37	0.16, 0.86
	0.44			
Linguistic region:				
• French	1		1	
• German	2.50	1.62, 3.86	2.70	1.71, 4.25
Smoking status				
• Non smoker	1		1	
• Occasional smoker	0.67	0.40, 1.15	0.70	0.41, 1.21
• Daily smoker	0.91	0.55, 1.50	0.86	0.51, 1.45
Nicotine dependence	1.20	0.76, 1.90	1.07	0.66, 1.73
Alcohol use disorder	1.56	0.94, 2.58	1.59	0.96, 2.65
Binge drinking				
• Never	1		1	
• Less than once a month	0.97	0.44, 2.15	1.01	0.45, 2.29
• Once a month or more	0.96	0.45, 2.07	1.09	0.50, 2.41
Weekly number of standard drinks	1.01	1.00, 1.03	1.01	1.00[b], 1.03
Use of illicit drugs other than cannabis	1.78	1.17, 2.70	1.88	1.23, 2.87
Cannabis status:				
• Less than twice a week	1		1	
• At least twice a week	3.42	2.24, 5.22	3.73	2.40, 5.81
Modes of administration of cannabis:				
• Joints with no tobacco			1.45	1.02, 1.76
• Joints with tobacco	1.44	1.19, 1.73	0.89	0.75, 1.04
• Water pipe with tobacco	0.87	0.74, 1.02	1.70	1.29, 2.24
• Water pipe with no tobacco	1.77	1.36,2.31	2.15	1.60, 2.87
• Food	2.12	1.62, 2.79	1.61	

	1.72	1.38, 2.14		1.29, 2.02
Cannabis use disorder	4.03	2.63, 6.17	4.19	2.70, 6.50
Sensation seeking	1.11	0.83, 1.49	1.04	0.77, 1.40

Note. [a]adjusted for age, linguistic region, education. [b]before rounding lower bound of the confidence interval is 1.000026. OR: odds ratio, 95% CI: 95% Confidence Interval.
In bold, results where $p < .05$.