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# Cannabis and caries – does regular cannabis use increase the risk of caries in cigarette smokers?

Key words: cannabis, marijuana, smoking, caries, dry mouth, oral health

**Summary** The use of cannabis by adolescents in Switzerland has almost doubled in the past decade. Empirical observations in private dental practices indicate that cannabis users have more carious lesions than those who do not use cannabis. The aim of this study was to investigate the hypothesis that regular cannabis use increases the risk of caries because of hyposalivation or lifestyle. Forty-three regular cannabis users were enrolled in the test group and 42 tobacco smokers were used as a negative control group. All subjects were 18–25 years old. Data were obtained using a standardized questionnaire and a clinical examination. There was no significant difference between groups in decayed and filled surfaces (DFS), saliva flow rate and plaque and gingival indices. The cannabis group had, however, significantly higher DS (decayed surface) values ( $p = 0.0001$ ) and significantly lower frequencies of daily tooth brushing and dental control

visits ( $p < 0.0001$ ) than the control group. Additionally, the cannabis group reported a significantly higher consumption of sugar-containing beverages than the control group ( $p = 0.0078$ ). To obtain more objective data relations, the DS values of male cannabis users were also compared with those of Swiss military recruits found in another study. The cannabis users had more caries on smooth surfaces than the military recruits. Although comparison with epidemiological data suggested that the prevalence of caries on smooth surfaces is elevated in cannabis users, DFS data indicated that cannabis users do not have an increased risk of caries. Lifestyle combined with short-term hyposalivation after delta-9-tetrahydrocannabinol consumption is the most probable cause of the high prevalence of caries on smooth surfaces in cannabis users. Further studies are needed to investigate the effects of cannabis use on oral health.

## Introduction

The use of cannabis is common in Europe. One out of five adults has used cannabis at least once in his or her lifetime. Once-in-a-lifetime use of cannabis is particularly prevalent among younger members of the population because 44% of 15–34-year-olds report using cannabis once. Estimates of the actual use of cannabis (use during the past 12 months) in 15–34-year-olds in Europe vary from 5%–20%. On a global basis, regular use of cannabis is highest in Canada and Spain (> 15%) and Switzerland (18.3%) (European Monitoring Centre

for Drugs and Drug Addiction [EMCDDA] 2002, BUNDESAMT FÜR STATISTIK 2004).

During the past decade, regular cannabis use by young people (15–24 years old) has increased in Switzerland. From 1992 to 2002, cannabis consumption almost doubled (from 9.8% to 16.3% in males and from 4.3% to 7.7% in females) (BUNDESAMT FÜR STATISTIK 2004). Among 15–16-year-old Swiss pupils, 49.9% of males and 39.1% of females had at least a once-in-a-lifetime experience with cannabis. The probability of young people using cannabis has increased since 1986. Males are more likely to use cannabis than females (SCHMID ET

AL. 2003); 41% of male and 33% of female 14–16-year-old Swiss teenagers reported an experience with cannabis. Twenty per cent of pupils reported using cannabis in the previous 30 days, 6.5% had used cannabis once or twice, 9.8% had used cannabis 3 to 39 times and 2.2% had used cannabis 40 times or more (split by gender: males 3.1%, females 1.3%) (GMEL ET AL. 2003).

Narring and coworkers differentiated between genders and between students and apprentices. Among 20-year-old males, 60% of apprentices and 73% of students had at least a once-in-a-lifetime-experience with cannabis. The majority of young people in Switzerland between the ages of 16 and 20 has used cannabis occasionally and 4% of females and 13% of males use it on a daily basis (NARRING ET AL. 2003).

The cannabis plant, *Cannabis sativa*, originated in central Asia and was introduced into India in the 8<sup>th</sup> century BC, where it was used for religious ceremonies and medical purposes. Subsequently, cannabis was widely used to treat gastric complaints, headaches, coughing, hepatitis, gout, “hard tumors”, tetanus and rabies. In the 20<sup>th</sup> century, the pharmaceutical importance of cannabis diminished because of the invention of drugs and vaccinations specific for many of the above-mentioned illnesses.

Cannabis contains 483 natural substances belonging to 19 classes of chemicals. Cannabis contains 66 cannabinoids. The most potent psychoactive substance is delta-9-tetrahydrocannabinol (THC). The effects of most of these substances on the human body are unknown. Although cannabis has medical potential, further knowledge on its biological effects and on appropriate forms of application is needed (GROTHENHERMEN 2001).

Cannabis is inhaled by smoking and is often mixed with tobacco. It can also be added to food. Cannabis is consumed in three main forms: marijuana (dried weeds and blossoms), hashish (pollen and resin) and hashish oil. The concentration of THC is 9.6% in marijuana, 14.8% in hashish and 66.4% in hashish oil (SCHLÄPFER 2005). The most common forms of cannabis use in Switzerland are marijuana (44%), hashish (22%) and a mixture of both (34%) (MÜLLER ET AL. 2001). When cannabis is smoked, effects occur within 2 to 3 minutes, peak within 10 to 20 minutes and diminish after 2 hours (DARLING 2003).

Cannabis smoke contains carcinogens similar to those in tobacco smoke but contains no nicotine (ELSOHLY 2001). One marijuana joint deposits four times as much tar in the respiratory tract as a tobacco cigarette of the same weight (TASHKIN 1999). According to HALL & MACPHEE (2002) “the experimental and epidemiological evidence of the cancer risks of cannabis use is still too meagre to warrant strong conclusions, but it raises concerns that for reasons of prudence should be communicated to cannabis users on public health grounds”.

The THC<sub>s</sub> of synthetic, biological or endogenous cannabinoids exert their effects throughout the body by interacting with receptors of the cannabinoid system, which was first identified in invertebrates and mammals. The human endogenous cannabinoid is called anandamide; its effects are similar to those of THC but are much weaker. Neuronal receptors called CB<sub>1</sub>s are located in the central nervous system (cerebellum, frontal cerebrum and hippocampus). As there are very few CB<sub>1</sub>s in the brainstem, vital functions are not affected by the use of cannabis. Therefore, a lethal dose of cannabis is improbable. Nevertheless, cannabis abuse has many adverse psychological and physiological effects (Table I).

The effects of cannabis are complex. Adolescents, in whom the nervous system is still developing, are especially vulnerable (EHRENREICH ET AL. 1999, WILSON AND NICHOLL 2001). Hyposalivation is of great interest to dental professionals for its negative effect on oral health (IMFELD 1984).

A search of the PubMed database, a service of the U.S. National Library of Medicine and the National Institutes of Health, using “cannabis” or “marijuana” and “caries” as key words returned only seven references. CHO (2005) and DARLING & ARENDORF (1992) reviewed the scientific literature on the effects of cannabis on oral health, including dry mouth. MADINIER (2002) discussed the illicit drugs that are used by regular drug users when they have toothache. PALLASCH (1987) described the effects of drug abuse on the oral cavity in general. DI CUGNO (1979) studied vitamin levels and oral status in 51 amphetamine and cannabis users in Buenos Aires, Argentina. He mentioned that xerostomia was a side effect of these drugs, but did not report on how this result was obtained. SILVERSTEIN ET AL. (1978) investigated a group of 206 people living in a commune in the USA in which cannabis and tobacco were used in addition to other drugs. The control group consisted

Tab. I Psychological and physiological effects of cannabis (GROTHENHERMEN 2001)

I	Psyche and perception	Sedation, euphoria, dysphoria, anxiety increase and decrease, depersonalization, intense sensoric perception, increased sexual sensation, changed time-relevance, hallucinations
II	Cognition and the psychomotor system	Fragmented thinking, distorted short-term memory and attention, associated thinking, increased creativity, ataxia, woolly language, better or worse movement coordination, decreased hyperkinetic movement distortion
III	Nervous system	Analgesia, muscle relaxation, increased appetite, emesis, anti-emesis, neuroprotection in ischemia and hypoxemia
IV	Body temperature	Decreased body temperature
V	Cardiovascular system	Tachycardia, increased heart load and oxygen need, vasodilatation, orthostatic hypotension, hypertension while lying, inhibition of thrombocytic aggregation
VI	Eye	Conjunctival redness, decreased tear water, decreased intraocular pressure
VII	Respiratory system	Bronchodilatation, hyposalivation with a dry mouth
VIII	Digestive system	Decreased intestinal motility and gastric emptying
IX	Endocrine system	Effect on LH, FSH, testosterone, prolactin, growth hormone, TSH, glucose homeostasis, decreased spermiogenesis, decreased sperm motility, menstrual cycle interruptions and inhibited ovulation
X	Immune system	Impairment of cellular and humoral immunity, immune stimulation, inhibition of inflammation
XI	Embryo development	Inhibition of growth, reduction in fetal and early brain development, impairment of cognitive capacity
XII	Genome and cancer	Antineoplastic activity, inhibition of the synthesis of DNA, RNA and proteins

of 68 people who did not smoke tobacco and did not live in a commune. The seventh report identified by the PubMed search, *Phytonicides in Dentistry* by SOLDAN (1953), was published in the Czech language and an English abstract was not available.

To our knowledge, our study is the first clinical investigation on the specific effects of cannabis use on oral health in smokers. The hypothesis tested in this study, i. e., that regular cannabis use increases the risk of caries, originated from empirical experience in dental private practice. Potential explanations are that the increased risk of caries is caused by THC-associated hyposalivation or lifestyle.

## Material & Methods

The study was approved by the SPUK ethics commission (Spezialisierte Unterkommission der Kantonalen Ethikkommission, Zürich) in April 2005 (StV 05/04). Informed consent was obtained from all participants.

According to Article 15 of the Swiss Health Statute, the investigators were not requested to report the subjects who used or abused cannabis to the police, and all information was confidentially because there was no evidence of delinquency among the subjects (BUNDESGESETZ ÜBER BETÄUBUNGSMITTEL UND PSYCHOTROPE STOFFE 812.121 [BetmG] 2007).

Participants were recruited through advertisements in free daily newspapers, short presentations at high schools and vocational schools, flyers and regional radio appeals. Participants were also encouraged to recruit their friends.

Cannabis users were recruited before defining the inclusion criteria for the control group because neither clinical data nor habits of cannabis users were well known. When examining the test group it was observed that all of them additionally smoked tobacco on a regular basis (at least ten cigarettes per day). In order to get similar group parameters with cannabis use as the main difference, tobacco use was defined as an inclusion criterion for the control group as well. If non-smokers had been chosen as a control group tobacco smoking would have become a confounding factor for the evaluation of the effect of cannabis use.

### *Inclusion criteria for the test group (cannabis users, group A):*

- (i) age 18 to 25 years,
- (ii) good general health,
- (iii) cannabis use (at least once per week),
- (iv) duration of cannabis use (at least two years).

### *Inclusion criteria for the control group (cannabis nonusers, group B):*

- (i) age 18 to 25 years,
- (ii) good general health,
- (iii) no cannabis use,
- (iv) tobacco use (at least ten cigarettes per day),
- (v) duration of tobacco use (at least two years).

### *Exclusion criteria for both groups:*

- (i) medical conditions affecting the oral cavity,
- (ii) use of other illicit drugs,
- (iii) pregnancy.

All participants completed a questionnaire to obtain data on demographics, psychological history, health status, dietary habits and daily oral hygiene. The cannabis group was also questioned about the frequency of drug use, their favorite form of cannabis, the age at which they first experienced cannabis,

whether they experienced a dry mouth after smoking cannabis, whether they would change their drug habits if they were associated with an increased risk of caries, and whether they would stop using cannabis if it was associated with an increased risk of developing cancer.

The participants were clinically examined by one researcher (M.S.). Two bitewing radiographs were taken. These were assessed by a second researcher (C.I.). The oral mucosa was investigated for abnormalities. Plaque and gingival indices (LÖE 1967) were measured buccally in the 1<sup>st</sup> and 4<sup>th</sup> quadrants and orally in the 2<sup>nd</sup> and 3<sup>rd</sup> quadrants. The level of decayed and filled surfaces (DFSs) (KLEIN ET AL. 1938) was determined. The M (missed surfaces) factor was omitted because third molars and teeth extracted for orthodontic reasons were not included in the analysis. Decayed lesions (D) were defined as dentine lesions detected radiographically or clinically. The DFS data of group A was compared with DFS data obtained from an epidemiological survey of Swiss military recruits in 2006 (MENGHINI ET AL., unpublished). The stimulated saliva flow rate was measured using a high-precision scale and saliva pH and buffer capacity were measured using an indicator system (pH 6.4–8.0; Merck KGaA, D-64271 Darmstadt) and a buffer analysis kit (CRT<sup>®</sup>, Ivoclar-Vivadent, FL-9494 Schaan), respectively.

Participants were not charged for the dental examination and were given duplicates of the bitewing radiographs. All participants received detailed information about their oral status and individual advice on prophylaxis (fluoride, oral hygiene, and nutrition). Patients were informed about the effects of regular oral hygiene, fluoridated toothpaste and gel and effective tooth brushing methods. If the patients reported unfavorable dietary habits (e. g., intake of beverages or food with a high sugar content), they were informed as to how their diet could be improved.

Urine samples were not obtained from the participants because self-reported cannabis use is not distorted by denial tendencies (GMEL 1998).

## Statistical analysis

As groups A and B were not paired in respect of gender, the data were only analyzed descriptively. Differences between the control and test groups within genders were analyzed using the Mann–Whitney and chi-squared tests.

## Results

### Gender, age, education and tobacco use

Forty-three participants were included in the test group (cannabis users, group A) and 42 were included in the control group (tobacco smokers, group B). In group A, 28 subjects were male (65%) and 15 were female (35%); in group B, 14 subjects were male (33%) and 28 were female (67%). The average age of participants was 22.6 years for group A and 23.2 years for group B.

Seventy percent of subjects in group A and 60% of subjects in group B were apprentices; 18% of subjects in group A and 33% of subjects in group B attended university or college; 12% of subjects in group A and 7% of subjects in group B were neither apprentices nor students.

Fifty percent of subjects in group A and 56% of subjects in group B smoked 10 cigarettes per day; 50% of subjects in group A and 33% of subjects in group B smoked 10–20 cigarettes per day; 9% of subjects in group B smoked more than 20 cigarettes per day.

Tab. II Daily tooth brushing in groups A and B (%)

Daily tooth brushing	Group A	Group B	Gender			
			Males A	Females A	Males B	Females B
0 ×	5	2	7	0	7	0
1 ×	42	2	43	40	7	0
2 ×	44	65	39	53	79	57
3 ×	9	31	11	7	7	43

### Frequency of daily tooth brushing

The frequency of daily tooth brushing is shown in Table II. Group A brushed significantly less than group B ( $p < 0.0001$ , chi-squared test).

### Frequency of dental visits

Twenty-one percent of subjects in group A and 74% of subjects in group B visited their dentist annually. Reasons for irregular or rare visits given by the remaining 79% of subjects in group A were anxiety (10%), no interest (25%) or financial constraints (65%). The difference in the frequency of dental visits between groups was significant ( $p < 0.0001$ , chi-squared test). There was no significant difference in the frequency of dental visits between genders within groups.

### Sweet snacks

Thirty-seven percent of subjects in group A and 43% of subjects in group B consumed one sugar-containing snack per day. Fifty-one percent of subjects in group A and 40% of subjects in group B ate 2–4 high-sugar snacks per day. There was no significant difference in the frequency of high-sugar snack consumption between groups.

### Beverages

Daily beverage consumption was categorized as water/tea (without sugar), soft drinks (carbonated drinks) and sweet drinks (iced tea, sweetened coffee or tea, and orange juice) (Table III). The beverage consumption of groups A and B was significantly different ( $p = 0.0078$ , chi-squared test).

### Cannabis use

The participants of group A had their first experience with cannabis at a mean age of 15 years. Of the participants in group A, 2.3% used cannabis once weekly; 25.6% used it several times

per week, 34.9% used it once per day and 37.2% used it several times per day. Seventy-nine percent used cannabis only in the evening and 21% began using cannabis in the morning or at noon. All subjects used cannabis by smoking it; 93% smoked marijuana (dried leaves) and 7% smoked hash (resin and pollen). Ninety-five percent smoked cannabis mixed with tobacco and 5% smoked pure cannabis. The incidence of hunger, thirst and consumption of food and drink after the use of cannabis are presented in Table IV.

### Oral hygiene

Seventy-two percent of group A subjects cleaned their teeth after using cannabis and 28% did not. Reasons given for neglecting oral hygiene were “too tired” (84%) and “didn’t feel like doing that” (16%).

### Willingness to change habits

When asked whether they would change their habits if it were proven that the risk of caries is increased by cannabis use, 79% of the participants of group A answered yes and 21% answered no. Forty-four percent of those who answered in the affirmative indicated that they would brush their teeth immediately after using cannabis, 44% indicated that they would improve their oral hygiene, 9% indicated that they would consume less sweets and 3% indicated that they would reduce their use of cannabis. When asked if they would stop smoking cannabis if it were proven that the risk of developing cancer is increased by cannabis use, 97% answered no and 3% answered yes.

### Clinical results

The gingival indices, plaque indices and stimulated saliva flow rates for groups A and B were 1.26 and 1.11, 1.21 and 0.90 and 1.9 and 1.8 ml/min, respectively; there was no significant difference between groups. In both groups, saliva buffer capacity was intermediate and saliva pH was 7.0. The incidence of DFS is presented in Table V. The incidence of DFS was not significantly different between groups ( $p = 0.2112$ ) when both genders were included in the analysis but differed when only males were included in the analysis ( $p = 0.0051$ , Mann–Witney test).

The incidence of decayed surfaces (DS) is also presented in Table V. The difference between groups was highly significant

Tab. III Beverage consumption in groups A and B (%)

Main beverage	Group A	Group B
Water/tea	62.8	88.1
Soft drinks	16.3	0.0
Sweet drinks	20.9	11.9

Tab. IV Behavior after using cannabis (%)

Hungry after cannabis use		Type of food consumed after using cannabis		Thirsty after cannabis use		Type of drink consumed after cannabis use		Dry mouth after using cannabis		Duration of dry mouth	
no	12			no	9			no	16		
yes	88	sweet	63	yes	91	water	69	yes	84	1 h	81
		salty	37			soft drinks	10			2–6 h	19
		sour	0			sweet drinks	21				

Tab.V DFS and DS in groups A and B

	Group A	Group B	Gender			
			Males A	Females A	Males B	Females B
DFS	8.07	6.76	9.14	6.07	2.50	8.48
DS	4.88	0.74	5.61	3.53	0.42	0.87

Tab.VI Detailed DS results for groups A and B

	Group A	Group B	Gender			
			Males A	Females A	Males B	Females B
D1–2 on smooth surfaces of molars	0.86	0.52	0.86	0.86	0.00	0.73
D3–4 on smooth surfaces of molars	0.74	0.05	1.04	0.20	0.08	0.03
D1–2 on smooth surfaces of anterior teeth	0.95	0.00	1.32	0.27	0.00	0.00
D3–4 on smooth surfaces of anterior teeth	0.60	0.07	0.82	0.20	0.00	0.10

( $p < 0.0001$ , Mann–Witney test). The number of DS in males differed between groups as did those of females (males,  $p = 0.0001$ ; females,  $p = 0.0016$ ; Mann–Witney test).

The clinical examination revealed a high prevalence of caries on smooth surfaces, which according to epidemiological data is uncommon for this age group in Switzerland. This was analyzed in greater detail by subdividing data according to the state of the lesion (initial [D1–2] or dentine [D3–4]) and its location (molars or front teeth) (Table VI). As groups consisted of small numbers of subjects and were not paired in respect of gender, these data were not subjected to statistical analysis.

## Discussion

Forty-three cannabis users with additional cigarette consumption and 42 tobacco smokers took part in the study. The groups were paired according to age but not according to gender. The inclusion and exclusion criteria were chosen for the following reasons. Eighteen was adopted as the lower age limit because in Switzerland people 18 years and older do not have to obtain their parents' permission to participate in a study such as this. Twenty-five was chosen as the maximum age in order to limit variation in age. The use of other illicit drugs was chosen as an exclusion criterion to limit the results to those of cannabis alone. Pregnancy was chosen as an exclusion criterion because radiography was performed on the subjects. Weekly cannabis use was chosen as an inclusion criterion for the test group because COFFEY ET AL. (2003) reported that the most important predictors of cannabis addiction are weekly cannabis use and regular tobacco smoking. As all cannabis users in our study smoked at least 10 cigarettes per day, control group subjects who smoked at least 10 tobacco cigarettes per day were selected. Out of 15 examined risk factors to become a cannabis user, the following three were found to be the most important ones: tobacco smoking, accessibility of cannabis and pessimistic health prospect. If these three factors are present the probability for cannabis use is 77% (SCHMID 2000). The pacemaker-hypothesis describes cannabis consumption as a consequence of precedent consumption of tobacco and alcohol (SFA-ISPA 2004). All cannabis users and tobacco smokers had to have been using the substances for at least two years before the trial because this interval is sufficient for the development of carious lesions.

Members of the test group started using cannabis at an average age of 15 years, which is in accordance with the results of MÜLLER & GMEL (2002), i. e., that teenagers begin to use can-

nabis before the age of 16. Cannabis users were initially recruited through advertisements in free daily newspapers. That more male ( $n = 28$ ) than female ( $n = 15$ ) cannabis users responded is in agreement with the results of SCHMID ET AL. (2003) and MÜLLER & GMEL (2002).

Urine samples were not obtained to verify cannabis use because GMEL (1998) showed that self-reported cannabis use is not distorted by denial tendencies. Furthermore, urine analysis would only have ascertained whether participants were positive or negative for THC and would have provided no information on the frequency and intensity of cannabis use.

It was difficult to balance the groups because all cannabis users recruited also smoked tobacco. Furthermore, 30% of potential participants did not show up for their examination appointment. Advertisements were placed in free daily newspapers to recruit age- and gender-paired tobacco smoking participants but the response was poor. Forty-two participants were eventually selected for the control group but there were fewer males ( $n = 14$ ) than females ( $n = 28$ ). It is unclear why the response of tobacco smokers to the advertisements was poor or why more females registered to participate in group B than in group A. Of 20–24-year-old Swiss residents, 42.2% smoke tobacco (SFA-ISPA 2004A); 39.9% of males and 34.8% of females smoke tobacco (GMEL ET AL. 2006). It is thus reasonable to assume that our widespread media advertisements would have been seen by a considerable number of tobacco smokers. Dental awareness is very high in Switzerland. Of the Swiss population, 75% visit a dentist once a year and 10% visit a dentist twice a year (IMFELD 2000). In our study, 74% of the control group reported having annual dental control visits. According to a survey conducted by the Swiss Dental Association, 90% of participants ( $n = 1125$ ) were satisfied with their dentist and 49% indicated that they would still visit the same dentist if they moved to a different suburb (KUSTER ET AL. 2000). Therefore, it is possible that for many tobacco smokers, the offer of a free dental consultation and bitewing radiographs may have been outweighed by a desire to be treated by their own dentists.

The groups were not paired in respect of education. In group A, apprenticeships prevailed, while in group B more participants had an academic education. Furthermore, tobacco consumption was not paired between genders within groups. Nevertheless, the study reaffirmed that cannabis use is widespread irrespective of level of education, which corroborates the results of MÜLLER & GMEL (2002).

There are no published clinical studies on the effects of cannabis per se on oral health. SILVERSTEIN's test group consisted

of vegetarians who used other drugs in addition to cannabis; control group subjects did not use drugs or tobacco but were not vegetarians (SILVERSTEIN ET AL. 1978). Di Cugno compared subjects who used both cannabis and amphetamines with subjects who did not use these drugs (1979). The only existing reports on cannabis and dental health are literature reviews, not clinical studies. Therefore, our study is the first clinical report on cannabis use and the prevalence of caries in smokers. Because of the small number of participants, who were not paired in respect of gender, the data were insufficient to support definitive conclusions. Nevertheless, several noteworthy tendencies emerged.

The frequency of tooth brushing and dental visits differed highly significantly ( $p < 0.0001$ ) between groups. There was no difference in the consumption of high-sugar snacks but there was a significant difference in the intake of sweet beverages ( $p \leq 0.0078$ ). Although these results suggest that cannabis users have a high risk of developing caries, plaque and gingival indices did not differ between groups. The incidence of DFS did not differ between groups A and B (8.07 vs. 6.76, respectively). When DFS data of male participants alone were analyzed, the difference between groups was significant (group A, 9.14; group B, 2.50;  $p = 0.0051$ ). However, this statistic should be interpreted with caution because the number of males in the test and control groups differed ( $n = 28$  and  $n = 15$ , respectively). On the other hand, the between-group difference in the incidence of DS was highly significant ( $p < 0.0001$ ). More untreated lesions were present in group A than in group B. This may be responsible for the impression of private practitioners that cannabis users have more caries than those who do not use cannabis, because untreated carious lesions, especially those at low-risk locations such as smooth surfaces, are a more obvious sign of caries than restorations.

In cannabis users, carious lesions were most prevalent on smooth surfaces (Fig. 1). The DS results of our study were compared with data from a 2006 epidemiological caries survey of Swiss military recruits (Table VII). In our study, cannabis users had a higher prevalence of caries than military recruits, when expressed as the number of DS on smooth surfaces. Caries lesions on smooth surfaces are indicative of high caries activity because these surfaces are easily brushed.

Statistical comparison of our data with that of the Swiss military recruit study was not done because participants in the latter study were representative of 20-year-old men and the dataset had a normal distribution of smokers and cannabis-using participants.

Saliva flow rates did not differ between groups (group A, 1.8 ml/min; group B, 1.9 ml/min), nor did pH or buffer capacity. Several authors have shown that salivation is reduced by atropine (CHO 2005, DARLING & ARENDORF 1992, DI CUGNO 1979, GROTENHERMEN 2001). In our study, 84% of the participants experienced a dry mouth after using cannabis and 91% felt thirsty, indicating that short-term hyposalivation occurs after using cannabis. There was no evidence of chronic hypo-



Fig. 1 Carious lesions on smooth surfaces in an 18-year-old cannabis user.

salivation, xerostomia or long-term reduction in buffer capacity or pH, even though 97% of the participants had used cannabis more than once weekly for more than two years. It would be of interest to examine saliva flow rate immediately after cannabis consumption. However, a request for study participants to use cannabis at a specific time could be interpreted as motivating them to use cannabis, which is illegal according to Article 19 of the Swiss Health Statute (BetmG 2007). According to 81% of the participants, a dry mouth persisted for up to an hour after using cannabis; 19% reported that it lasted between 2 and 6 hours. Of all cannabis users, 63% ate sweet food, 31% drank sweet beverages (soft drinks or noncarbonated sweet drinks) after using cannabis and 28% did not clean their teeth after using cannabis or before sleeping (most cannabis users consume cannabis and sweet foods or beverages during the evening). Such behavior increases the risk of caries and may be aggravated by a dry mouth.

Tab. VII Comparison of DS results of the present study and those of a 2006 survey of Swiss military recruits

	<b>Males A n = 28</b>	<b>Males B n = 15</b>	<b>Swiss recruits n = 606</b>
D1–2 on smooth surfaces of molars	0.86	0.00	0.59
D3–4 on smooth surfaces of molars	1.04	0.08	0.09
D1–2 on smooth surfaces of anterior teeth	1.32	0.00	0.44
D3–4 on smooth surfaces of anterior teeth	0.82	0.00	0.12

That smoking cannabis may increase the risk of developing cancer (TASHKIN 1999) did not influence the participants' attitude to the use of cannabis: 97% answered that they would not stop using cannabis despite the risk of cancer. Surprisingly, 79% indicated that they would change their routine if cannabis were proven to affect their teeth, 44% answered that they would brush their teeth after consuming cannabis and sweet beverages or foods and 44% indicated that they would improve their oral hygiene.

The hypothesis that cannabis increases the risk of caries was not confirmed by the results of this study. However, the difference between groups in the incidence of DS was highly significant. Cannabis users had considerably more open carious lesions than those who did not use cannabis. Short-term xerostomia and consumption of cariogenic food and beverages after using cannabis may be responsible for the high incidence of caries on smooth surfaces. The cariogenic diet, reduced frequency of oral hygiene and rare dental control visits indicate that the lifestyle of cannabis users makes an important contribution to the incidence of caries. Therefore, the combination of cannabis use and an unhealthy lifestyle increases the risk of caries on smooth surfaces. The finding that cannabis users indicated that they would change their oral hygiene if their addiction resulted in an increased risk of caries, suggests that oral health education by private practitioners and prophylaxis personnel would be a successful preventive measure. The effects of cannabis on oral health have not been thoroughly investigated. Further studies are needed to gain more insights into this interesting field.

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## Zusammenfassung

Im letzten Jahrzehnt hat sich der Cannabiskonsum unter Schweizer Jugendlichen fast verdoppelt. Empirische Beobachtungen aus der Privatpraxis lassen vermuten, dass Cannabiskonsumenten mehr Karies haben als Nichtkonsumenten. In der vorliegenden Studie wird untersucht, ob regelmässiger Cannabiskonsum zu einem erhöhten Kariesrisiko führt. Die möglichen Ursachen (1) Hyposalivation und (2) Lifestyle werden diskutiert.

43 Cannabis- und 42 Tabakkonsumenten (18- bis 25-jährig) wurden untersucht. Die Daten der Probanden wurden mittels standardisierten Fragebogens und klinischer Untersuchung erfasst.

Zwischen der Studien- und Kontrollgruppe gab es keine signifikanten Unterschiede bei den DFS-Werten, den Plaque- und Gingivaindizes und der Speichelfliessrate. Bei den Cannabiskonsumenten waren der DS-Wert signifikant erhöht ( $p = 0,0051$ ), die tägliche Mundhygiene und Kontrollbesuche beim Zahnarzt signifikant seltener ( $p < 0,0001$ ) und der Konsum von Süssgetränken signifikant häufiger ( $p = 0,0078$ ). Die DS-Werte an Zahnglattflächen der männlichen Cannabiskonsumenten wurden verglichen mit den entsprechenden Daten der periodischen Rekrutenuntersuchung. Bei den Cannabiskonsumenten wurde deutlich mehr Glattflächenkaries festgestellt.

Gemäss den DFS-Werten kann kein erhöhtes Kariesrisiko bei Cannabiskonsumenten gegenüber der Kontrollgruppe nachgewiesen werden. Es liegt aber eine deutlich erhöhte Prävalenz von Glattflächenkaries gegenüber epidemiologischen Daten vor. Der Lifestyle verbunden mit einer kurzfristigen Hyposalivation nach THC-Konsum wird als mögliche Ursache angenommen. Weitere Untersuchungen sollten den Einfluss des Cannabiskonsums auf die orale Gesundheit erforschen.

## Résumé

En Suisse, la consommation de cannabis par les adolescents a presque doublé dans les dernières dix années. L'observation empirique des dentistes privés prête à croire que les consommateurs de cannabis ont plus de caries que les non-consommateurs. La présente étude examine si la consommation régulière de cannabis augmente le risque de caries et discute les causes probables (1. l'hyposalivation ou 2. le style de vie de ces jeunes gens).

Un groupe de 43 consommateurs de cannabis et un groupe de contrôle de 42 consommateurs (de 18 à 25 ans) de tabac ont été examinés. Au moyen d'un questionnaire standardisé et d'un examen clinique les données des participants ont été prises.

Il n'est pas résulté de différences significatives en ce qui concerne les valeurs de DFS, ni pour ce qui est des tests de salive ainsi que des indices gingivaux et de plaque. Dans le groupe cannabis les résultats de DS étaient significativement plus élevés ( $p = 0,0051$ ), les résultats quant à l'hygiène orale quotidienne et aux visites de contrôle chez le dentiste étaient significativement plus mauvais ( $p < 0,0001$ ) et par ailleurs, les consommateurs de cannabis buvaient significativement plus de boissons sucrées ( $p = 0,0078$ ). Les résultats de DS aux surfaces lisses pour les hommes du groupe cannabis ont été comparés aux résultats corrélatifs de l'examen périodique de caries des recrues suisses. Chez les consommateurs de cannabis, on a constaté fortement plus de caries aux surfaces lisses.

Le DFS ne permet pas de constater un risque accru de caries. Cependant il y a une prévalence accrue de caries aux surfaces lisses face aux données épidémiologiques. Comme source probable on agréé le lifestyle embranché à l'hyposalivation à court terme après avoir consommé THC.

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