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Substance use as a function of activity level among young Swiss men

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Summary

Adolescence is a period of life during which many people experiment with different kinds of legal and illegal substances. However, young people practising physical activities at a high level should avoid taking such substances. On the basis of a large sample of Swiss male recruits (C-SURF baseline data), we explore the consumption of substances among three subgroups of young adults, defined according to level of physical activity: high, medium, and low.

Our results show that respondents classified into the high level of physical activity group went through the same experimentation processes with substances as respondents in the other groups, but that they reduced their overall consumption level, as indicated by measures regarding the last 12 months only. However, substantial differences are observed when we look at each substance separately. In particular, smokeless tobacco products are consumed more in the high group, and alcohol consumption is high in all groups.

Physical activity, even at a high level, is not a protective factor against substance consumption. Therefore, physicians should not forget to investigate substance use among people with high levels of physical activity, especially since their consumption can (1) differ from the general population; and (2) have important consequences on their physical performance.

Keywords: *substance use, physical activity, young adult, male, Switzerland*

Introduction

Many adolescents and young adults experiment with substances, both legal and illegal [1]. Although most of these experimentations are brief and without important, long-time adverse consequences, they can sometimes have much more problematic outcomes, including developmental issues and addiction [2]. On the other hand, the practice of sport, or more generally of physical activity, at a high level implies, at least in the collective imagination, a healthy lifestyle. Therefore, there is a strong contrast between the usual experimentation during adolescence and the specific situation of people whose lifestyle involves a

high level of physical activity. In this paper, we investigate the link between level of physical activity and substance use in a sample of Swiss male recruits. Our goals are to determine whether significant differences in substance use as a function of the level of physical activity exist, and whether the practice of physical activity at a high level can be considered a protective factor against substance use.

Adolescence and substance experimentation

Adolescence is a period in life during which individuals seek independence from their parents and attain adult status. This transition implies a number of steps, such as moving from the education system to the job market, becoming sexually active, leaving the parental home and establishing lasting romantic partnerships [3]. Moreover, as a means of gaining independence and affirming their status as no-longer children, many adolescents also experiment with a wide range of behaviours, including incivility, risk taking and substance use, whether legal or illegal [4].

All these experimentations are considered normal within the context of adolescence, but if they are uncontrolled, they can have important adverse consequences in both the short and the long term. This is especially true for substance use, since the earlier a person is introduced to substance use, the more likely s/he is to develop addictions later on [5]. Without fully following the gateway theory [6, 7], we may say that adolescents commonly experiment with several substances, either successively or simultaneously, and specific patterns of substance initiation can be identified [8]. Moreover, the number of different substances (especially synthetic ones) and their availability seem to have increased during the last few decades [9], and the development of products such as energy drinks, alcopops (mixes of soda with strong alcohol), e-cigarettes and legal cannabis (cannabis without THC) is considered by experts to provide new ways of introducing young people to substance use [10, 11].

The specific case of people with a high level of physical activity

All individuals, whatever their level of physical activity, pass through the transition from childhood to adulthood, and they are therefore exposed to the possibility of substance use experimentation. However, people with a high

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level of physical activity, elite athletes for example, represent a specific case. Indeed, substance use can have a direct impact on their performances, either by diminishing them or by boosting them, perhaps illegally. In particular, as some substances, such as cannabis and cocaine, are considered doping products [12], competitive athletes should respect the legal frameworks governing their sports and totally avoid using these at all times [13, 14]. Moreover, substances can also be used by athletes to reduce the stress linked to competition and to help them recover after great exertion [15]. These factors might dissuade them from consuming substances or encourage them to use different substances to those consumed by their non-athlete peers. It should also be stressed that although substance use seems clearly in contradiction with the practice of sports at a high level, it is nevertheless known to be part of some situations related to sports, such as post-competition celebrations. Therefore, there is a strong interest in determining whether adolescent athletes follow the same pattern of experimental substance use as their non-athlete peers. This question extends beyond elite sport to all people with a high level of physical activity, including people with physically strenuous work, since the use of substances also interferes with their performance.

Overall, contradictory findings have been found regarding the prevalence and level of substance use among athletes. While tobacco and cannabis use were found to be less prevalent among adolescent athletes than their more sedentary peers [16, 17], other authors found a higher rate of alcohol abuse in college athletes than non-athletes [18]. A higher risk of excessive alcohol consumption has also been observed among sports-practising youths [19]. Moreover, the use of snus (a smokeless tobacco product) has been well documented among hockey players and other athletes [20–23], and many professional dancers are smokers or alcohol abusers [24].

Research question and hypotheses

In Switzerland, published data indicate that 46.7% of Swiss recruits participated in a vigorous sport or physical activity at least three times a week in 2011 [25], but there is no further indication of the regularity of this practice, nor of the length of each session. We also know that 34% of 15–24 year old males living in Switzerland consume tobacco, and that 78.9% drink alcohol. Finally, the life prevalences of cocaine, ecstasy and heroin consumption among 14–49 year old males living in Switzerland are 6.7%, 6.0% and 0.8% respectively [26]. However, even though substance users and people with a high level of physical activity are two population groups that have been the subjects of many studies, the general link between substance use and level of physical activity is much less discussed in the literature [16]. Moreover, studies have generally focused on only one substance, such as alcohol or tobacco. Therefore, we sought to fill this gap by taking a more comprehensive view and including many substances that are used specifically among people with a high level of physical activity, and by comparing them with their peers who have either a lower level of physical activity or almost no physical activity at all. We hypothesised that (1) young people with a high level of physical activity generally experiment with the same substances as other adolescents; (2) overall, the regularity of substance consumption decreases as the lev-

el of physical activity increases; and (3) for specific substances, the consumption reported by young people with high levels of physical activity can be higher than that of other people. Understanding both the differences in substance use according to the level of physical activity and the protective effect of sport and other physical activities will aid the development of efficient public health policies targeting athletes specifically.

Methods

Data

Our data come from the baseline wave of the Cohort Study on Substance Use Risk Factors (C-SURF) [27], a Swiss survey conducted to study substance consumption among young males. The sample of the C-SURF study comprises male Swiss citizens recruited for mandatory military service in the Swiss army. In Switzerland, military service is mandatory for all male citizens, and a two-day recruitment period is organised each year. All young Swiss males who participated in this recruitment process during the period from August 23, 2010 to November 15, 2011 in three different recruitment centres, covering 21 of the 26 Swiss cantons, were invited to participate in the study (baseline). Two follow-ups were later held during the periods 2012–2014 and 2016–2018, but these data were not used in this article.

The sample includes recruits who agreed to answer the baseline questionnaire at home a few days after the recruitment. Of the 7556 individuals who signed the consent form, 5987 (79.2%) completed the questionnaire. The participants were asked questions on a variety of topics, including socio-professional status, family background, lifestyle, personality, substance consumption, use of the internet, gambling and gaming activities, sexuality, physical and mental health, and knowledge about other health-related aspects. Anonymity was guaranteed, with the contact details of the participants being managed independently of their answers.

More details about the design of the study and the data collection, including a flowchart of the participants, are available elsewhere [27] and on the C-SURF website (www.csurf.ch). The study protocol was approved by Lausanne University Hospital Clinical Research Ethics Committee (Protocol No. 15/07).

Variables

Level of physical activity

To address our research question, we split the sample according to the level of physical activity of the respondents in order to identify those participants with the highest levels of physical activity. However, the C-SURF questionnaires include no questions which directly identify such people. Therefore, we had to construct a synthetic variable from the answers to the following three questions:

1. Frequency question: During the last seven days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics or fast cycling? Possible answers: none, one, ..., seven days per week.
2. Duration question: How much time in total did you usually spend on one of those days doing vigorous

physical activities? Answer to be given in hours and minutes.

3. Regularity question: How often did you actively participate in sports, athletics or exercising in the past 12 months? Possible answers: never, a few times a year, once to three times a month, at least once a week, almost every day.

The first two questions originate from the short version of the International Physical Activity Questionnaire (IPAQ) [28, 29], that makes no distinction between sports and job activities. Therefore, the answers might refer to sports activities, job activities, or both. For instance, a construction worker can score very high on these questions even if s/he never practises sports. It would have been possible to use the profession of the respondent to better discriminate between participants, but this information was not sufficiently precise in the C-SURF database.

When speaking of a high level of physical activity, it is implicit that this activity is long-term, so we had to ensure that we did not include in this group people who were practising intensively only at the time of their recruitment. Therefore, our definition of level of physical activity had to incorporate a measure of the regularity of this practice, hence the use of the third question above. We defined the meaningful groups based on both intensity and regularity of physical activity. By combining these two concepts, we were able to distinguish between people doing sports or physical activities regularly and at a high level, people doing physical activities regularly but at a much lower level, and people practising almost no physical activities. Formally, we defined four groups of respondents on the basis of the three questions above (fig. 1). The first three groups (low, medium and high levels of physical activity) are on the right of this figure and are well defined, but the fourth is much more composite. It comprises all respondents whose physical activity level was unclear or varied greatly over time. Therefore, we chose to exclude these people from consideration and performed substantive analyses on the first three groups only.

Substance use

All substances considered in the C-SURF questionnaire were analysed, including alcohol, cannabis, tobacco (cigarettes, water pipes, cigars or cigarillos, snus, snuff, and chewing tobacco), other illicit drugs (e.g., hallucinogens, speed, cocaine, heroin), and prescription drugs used without a doctor's prescription. For most substances, we had information on use (entire life and last 12 months), age at first use, and frequency and quantity of consumption. For an exhaustive list of all substances included in this study, please refer to tables 1 to 8 below.

Socio-demographic characteristics

For descriptive purposes, we also considered three socio-demographic variables, which we used to characterise the respondents in each group of physical activity level: age, Swiss language region (French or German) and education level.

Statistical analyses

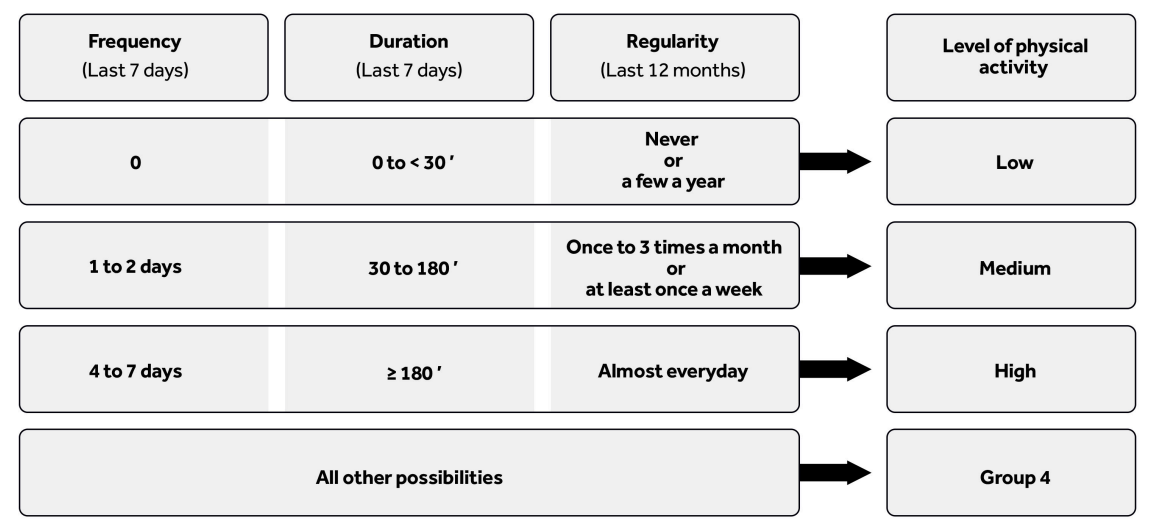
The three activity groups were compared regarding all socio-demographic and substance use variables. We used the chi-squared test for categorical variables and a one-way ANOVA for continuous variables. When the test was significant at the 5% level, we performed post hoc analysis to compare the high physical activity group with each of the other groups. A Bonferroni adjustment was performed for these comparisons in order to avoid rejecting the null hypothesis too easily. Since we performed two post hoc comparisons for each substance, the p-values reported for post hoc comparisons should be compared to a Type I error of 2.5% instead of 5%. Stata 15.1 (Stata Corporation, College Station, TX, USA, <http://www.stata.com>) was used for all computations [30].

Results

Participants

The design of the C-SURF study means that the sample comprised only male Swiss citizens from the French and German parts of the country. After deleting people with data missing for any of the variables used to define the

Figure 1: Partition of the respondents into four groups as a function of their answers to the three questions regarding frequency, duration and regularity of physical activity.



groups of physical activity ($n = 63$), and without considering respondents assigned to the fourth group ($n = 4274$), we ended up with a sample of size $n = 1650$. **Table 1** gives the main characteristics of this sample. At baseline, the mean age of the whole sample was 20.03 years (SD 1.28; range 18–26), 60.1% of the respondents were from the French-speaking part of the country, and 48.96% of them had mandatory education as their highest achieved education level. When we compare the high physical activity group with the two other groups, we see that its members are younger, that many more of them come from the German part of Switzerland, and that their education level is lower.

Alcohol

Differences in alcohol consumption across the three levels of physical activity are very small (**table 2**). The main differences between the high group and the other two groups are regarding having consumed alcohol during the last year (more common in the high group than the low group, $p < 0.005$, and less common in the high group than the medium group, $p < 0.001$) and the usual number of days the respondents drink each week (no significant difference between high and low groups, but significantly fewer members of the high group usually drink twice a week compared to members of the medium group, $p = 0.011$). On the other hand, on days when alcohol is consumed, no significant difference is found between the three groups regarding the average number of drinks they take.

Tobacco

Overall, tobacco (whether smoked or not) had been tried by significantly fewer members of the high group than of the medium group ($p = 0.008$), but no difference was found between the high and low groups (**table 3**). However, important differences appear between the groups regarding the different tobacco products. Considering smoked products first, members of the high group are generally less likely to have consumed these than members of the other two groups, whatever the product (cigarette, water pipe, cigar, pipe). This is true for consumption of the product both ever and during the last 12 months, with the exception of pipes, where no significant differences were found, perhaps due to the small number of users. However, the age at first use did not differ significantly between the groups. Moreover, when the product is consumed, the frequency of consumption tends to be higher in the high group than in at least one of the other two groups, although these differences are not significant.

The picture is very different for smokeless tobacco products (**table 4**). Members of the high group are generally more likely to have consumed these products, especially during the last 12 months, and their frequency of consumption is systematically higher. In the case of snuff, they also started at a significantly lower age than members of the low and medium groups. However, it must be noted that these smokeless products are consumed much less overall than the smoked products. Snuff was used the most during the last 12 months (by 21.95% of the respondents), and chewing tobacco was used the least (0.43%).

Given the observed differences in prevalence between smoked and smokeless tobacco, we decided to examine the relationship between the two types of tobacco product and level of physical activity in more detail. Therefore, we

Table 1: Socio-demographic characteristics of the respondents belonging to the low, medium and high physical activity groups.

		Level of physical activity			Overall n = 1650	p-value	Post hoc test	
		Low (1) n = 338	Medium (2) n = 996	High (3) n = 316			1 vs 3	2 vs 3
Age		20.54	19.92	19.82	20.03	<0.001	<0.001	0.710
Swiss region	French-speaking	81.07	61.04	34.49	60.06	<0.001	<0.001	<0.001
Education level	Mandatory	38.02	50.15	56.96	48.96	<0.001	<0.001	<0.001
	Vocational and other	42.81	31.24	34.95	34.31			
	High school	19.16	18.60	8.09	16.73			

Table 2: Alcohol consumption by level of physical activity.

Question	Category	Level of physical activity			Overall	p-value	Post hoc test	
		Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3
Have you drunk at least one standard drink with alcohol?	Yes	92.56	97.38	95.56	96.05	<0.001	0.107	0.101
At what age have you drunk at least one standard drink with alcohol?		14.49	14.46	14.64	14.50	0.349		
How old were you when you were drunk for the first time?		15.59	15.59	15.55	15.58	0.945		
Entire life: at least 12 drinks of any kind of alcohol?	Yes	86.13	91.11	90.03	89.92	0.040	0.137	0.573
Last 12 months: at least 1 drink of any kind of alcohol?	Yes	82.74	95.87	90.45	92.15	<0.001	0.005	<0.001
How many standard drinks do you drink on average on days when you drink alcohol?		4.18	4.23	4.57	4.29	0.352		
How often do you usually drink alcohol?	Never	3.61	0.84	3.17	1.78	<0.001	0.480	0.011
	Almost 3 times a month	31.77	29.94	31.34	30.54			
	Almost 2 days a week	42.24	52.21	44.72	48.98			
	Almost 4 days a week	13.36	12.92	15.49	13.48			
	At least 5 days a week	9.03	4.10	5.28	5.22			

separated our sample into four groups: respondents without any tobacco consumption during the last 12 months, respondents who had consumed only smoked tobacco, respondents who had consumed only smokeless products, and respondents who had consumed both types of products. Table 5 summarises our findings. The results show that although more of the high group have consumed smokeless tobacco, a highly significant proportion of this same group (22.26%) have consumed both smokeless and smoked tobacco. Therefore, we cannot really speak of substitution between the two types of tobacco product, and a large majority of tobacco consumers in the high group have used smoked tobacco.

Cannabis

The percentage of respondents who have ever consumed cannabis (table 6) is significantly lower in the high group than in the low and medium groups (41.27% vs 50.15% and 51.76%). Consumption during the last 12 months follows the same trend (20.00% vs 32.05% and 36.08%). On the other hand, the age at first use of cannabis is similar in all three groups, with no significant differences found. Moreover, among cannabis consumers, the distri-

bution of the frequency of consumption does not differ significantly between the high and the other two groups. Members of the high group consume cannabis mainly for fun (96.61%). This is similar to what is observed in the medium group, but it differs significantly from the low group, where 19.44% of respondents declare that consuming cannabis is part of their daily life.

Differences between the groups regarding the different modes of cannabis consumption are small, but members of the high group consume joints made of a mix of tobacco and cannabis (a process called mulling) less often than members of the low group, and they use a water pipe to consume cannabis, with or without added tobacco, more often.

Other illicit substances

Few respondents in our sample are consumers of hallucinogens, amphetamines, speed, ecstasy or other illicit substances. The overall proportions of respondents who have consumed such substances during their entire life and during the last 12 months are 10.07% and 6.42% respectively (table 7). More participants (5.76%) have ever consumed hallucinogens than any of the other substances, while amphetamines have been used the least. Regarding use in the

Table 3: Smoked tobacco consumption by level of physical activity.

Question		Category	Level of physical activity			Overall	p-value	Post hoc test		
			Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3	
Have you ever consumed tobacco (smoked or not)?		Yes	67.16	71.18	63.29	68.85	0.023	0.299	0.008	
Last 12 months: consumption of smoked tobacco at least once		Yes	59.52	62.22	50.65	59.47	0.001	0.023	<0.001	
Cigarettes	Entire life consumption	Yes	64.50	62.44	53.18	61.09	0.005	0.003	0.004	
	Last 12 months consumption	Yes	52.66	48.99	36.62	47.38	<0.001	<0.001	<0.001	
	Age at first use			14.91	14.80	14.90	14.84	0.799		
	On a usual day, how many cigarettes do you smoke?			11.27	6.81	9.41	8.21	<0.001	0.078	0.001
	How many days a week?	1 to 2	13.48	27.57	19.13	23.11	<0.001	0.150	0.102	
	3 to 4	12.36	19.34	17.39	17.46					
	5 to 7	74.16	53.09	63.48	59.44					
Water pipe	Entire life consumption	Yes	54.01	62.60	51.27	58.67	<0.001	0.485	<0.001	
	Age at first use			15.76	15.47	15.35	15.50	0.050	0.066	1.000
	Last 12 months consumption	Yes	33.79	44.55	35.02	40.64	0.001	0.757	0.005	
	On a usual day, how many water pipes do you smoke?			1.44	1.58	1.84	1.60	0.373		
	How many days a month?	0 to 1	88.89	79.46	75.26	80.33	0.041	0.013	0.365	
	At least 2	11.11	20.54	24.74	19.67					
Cigars	Entire life consumption	Yes	41.25	48.49	30.79	43.61	<0.001	0.006	<0.001	
	Age at first use			16.22	16.07	15.81	16.06	0.209		
	Last 12 months consumption	Yes	23.15	31.38	18.10	27.15	<0.001	0.112	<0.001	
	On a usual day, how many cigars/cigarillos do you smoke?			1.69	1.76	1.84	1.76	0.038	0.033	0.346
	How many days a month?	0 to 1	79.49	82.64	75.44	81.17	0.405			
	At least 2	20.51	17.36	24.56	18.83					
Pipe	Entire life consumption	Yes	6.25	9.68	6.73	8.41	0.073			
	Age at first use			14.90	16.34	16.00	16.07	0.062		
	Last 12 months consumption	Yes	2.38	4.34	2.88	3.66	0.184			
	On a usual day, how many pipes do you smoke?			2.38	1.30	1.33	1.45	<0.01	0.060	1.000
	How many days a month?	0 to 1	62.50	79.07	66.67	75.00	0.502			
	At least 2	37.50	20.93	33.33	25.00					

last 12 months, ecstasy and MDMA were consumed by the most participants (3.52%), and amphetamines were used the least. Differences between the groups were found for most substances. All the substances were consumed more by members of the low group than by members of the others (except speed during the last 12 months), but no significant differences between the medium and high groups were found.

Prescribed drugs consumed without medical prescription

The consumption of these substances is quite low in our sample (table 8). The overall proportion of participants who have consumed any of the substances during the last 12 months is 11.04%. The most used substance is strong painkillers (6.14% of the respondents), followed by sleeping pills and tranquilizers (3.28% each). No significant differences between the three groups were found regarding sleeping pills and strong painkillers. Regarding the other drugs, the use of antidepressants was more prevalent in the low group than in the high group, and the use of anabolic

steroids was more prevalent in the high group than in the medium group.

Discussion

In this study we examined the relationship between level of physical activity and substance consumption in young Swiss men. We hypothesised that (1) young people with a high level of physical activity generally experiment with the same substances as other adolescents; (2) overall, the regularity of substance consumption decreases as the level of physical activity increases; and (3) for specific substances, the consumption reported by young people with high levels of physical activity can be higher than that of other people.

Overall, these hypotheses are supported by our results, but with several nuances, especially regarding the first hypothesis. The prevalence of alcohol consumption does not differ between the high physical activity level group and the other two groups, and excessive alcohol consumption is observed in all groups. This is in line with the literature [17, 19]. However, this is not the case for smoked tobacco

Table 4: Smokeless tobacco consumption by level of physical activity.

Question	Category	Level of physical activity			Overall	p-value	Post hoc test		
		Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3	
Last 12 months: consumption of smokeless tobacco at least once	Yes	14.54	26.67	29.49	24.71	<0.001	<0.001	0.330	
Chewing tobacco	Entire life consumption	Yes	0.00	1.31	2.55	1.28	0.015	0.003	0.129
	Age at first use		-	16.38	15.62	16.10	0.449		
	Last 12 months consumption	Yes	-	0.30	1.27	0.43	0.028	0.038	0.040
	On a usual day, how many portions of chewing tobacco do you take?		-	1.00	2.00	1.57	0.093		
	How many days a month?	0 to 1	-	100	25.00	57.14	0.047	-	0.047
	At least 2	-	0.00	75.00	42.86				
Snus	Entire life consumption	Yes	9.50	14.36	20.45	14.52	<0.001	<0.001	0.010
	Age at first use		16.44	16.84	16.56	16.71	0.388		
	Approximately how old were you when you started using snus on a daily basis?		14.67	17.64	16.13	16.66	0.041	0.789	0.165
	Last 12 months consumption	Yes	1.48	7.58	13.10	7.38	<0.001	<0.001	0.003
	How many portions do you consume on a usual day?		2.80	2.76	3.90	3.15	0.455		
	How many days a month?	<2 to 3 / month	80.00	77.03	65.85	73.33	0.406		
		At least 4 / per month	20.00	22.97	34.15	26.67			
Snuff	Entire life consumption	Yes	33.23	43.61	40.32	40.85	0.004	0.061	0.304
	Age at first use		15.22	15.27	14.49	15.11	<0.001	0.012	<0.001
	Approximately how old were you when you started using snuff on a daily basis?		14.75	15.58	14.81	15.19	<0.001	<0.001	<0.001
	Last 12 months consumption	Yes	14.20	23.29	26.03	21.95	<0.001	<0.001	0.320
	On a usual day, how many portions do you take?		2.37	2.70	4.35	3.04	0.026	0.063	0.049
	How many days a month?	<2 to 3 / month	87.50	88.31	70.37	84.17	0.001	0.026	<0.001
		At least 4 / month	12.50	11.69	29.63	15.83			

Table 5: Relationship between smoked and smokeless tobacco consumption during the last 12 months.

Category	Level of physical activity			Overall	p-value	Post hoc test	
	Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3
No tobacco consumption	39.88	35.39	42.26	37.61	<0.001	<0.001	<0.001
Smoked tobacco only	45.83	38.02	28.39	37.80			
Smokeless tobacco only	0.60	2.43	7.10	2.94			
Both smoked and smokeless tobacco	13.69	24.17	22.26	21.65			

co products, cannabis, other illicit drugs and prescribed drugs. Although a sizeable number of young adults doing physical activity at a high level experiment with these substances, fewer do so than among their less athletic peers. However, non-smoking tobacco products constitute an exception, since these substances have been tried at least

Table 6: Cannabis consumption by level of physical activity.

Question	Category	Level of physical activity			Overall	p-value	Post hoc test	
		Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3
Have you ever smoked cannabis (hashish, marihuana, grass), more than one drag to try it out?	Yes	50.15	51.76	41.27	49.42	0.005	0.023	0.001
Age at first use		15.77	15.88	15.89	15.86	0.719		
Last 12 months consumption	Yes	32.05	36.08	20.00	32.18	<0.001	<0.001	<0.001
How often do you smoke cannabis?	Almost once per month	38.89	60.72	53.97	55.47	<0.001	0.198	0.565
	2 to 4 times per month	12.04	10.58	9.52	10.75			
	2 to 3 times per week	8.33	11.42	11.11	10.75			
	4 to 5 times per week	10.19	8.08	9.52	8.68			
	Almost every day	30.56	9.19	15.87	14.34			
Which of the following statements best fits your personal situation?	I smoke cannabis for fun, because it is something special.	80.56	95.21	96.61	92.34	<0.001	0.004	0.634
	I smoke cannabis out of habit, because it is part of my daily life.	19.44	4.79	3.39	7.66			
Consumption mode: joint of pure cannabis (without tobacco)	Never	50.94	61.58	52.46	58.35	0.235		
	Rarely	35.85	25.99	31.15	28.60			
	Sometimes	13.21	12.43	16.39	13.05			
Consumption mode: joint of cannabis and tobacco	Never	1.87	1.96	4.76	2.28	0.022	0.018	0.384
	Rarely	8.41	21.01	22.22	18.60			
	Sometimes	89.72	77.03	73.02	79.13			
Consumption mode: water pipe (bong) with tobacco	Never	65.38	72.32	69.35	70.58	0.014	0.273	0.004
	Rarely	22.12	21.47	12.90	20.58			
	Sometimes	12.50	6.21	17.74	8.85			
Consumption mode: water pipe (bong) without tobacco	Never	74.53	80.68	72.58	78.46	0.044	0.700	0.015
	Rarely	15.09	14.49	12.90	14.42			
	Sometimes	10.38	4.83	14.52	7.12			
Consumption mode: mixed with food (cooking, tea, etc.)	Never	50.94	63.20	55.56	59.81	0.197		
	Rarely	35.85	28.37	33.33	30.48			
	Sometimes	13.21	8.43	11.11	9.71			
Consumption mode: other ways	Never	84.91	91.76	80.95	89.06	0.066		
	Rarely	10.38	5.68	12.70	7.49			
	Sometimes	4.72	2.56	6.35	3.45			

Table 7: Consumption of other illicit substances by level of physical activity.

Question	Category	Level of physical activity			Overall	p-value	Post hoc test		
		Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3	
Entire life	At least one consumption of an illegal substance	Yes	15.09	8.94	8.23	10.07	0.003	0.007	0.695
	Hallucinogens, magic mushrooms, psilocybin, peyote, mescaline	Yes	9.17	4.82	5.06	5.76	0.01	0.042	0.864
	Other hallucinogens (LSD, PCP/Angel dust, 2-CB, 2-CI)	Yes	8.31	3.12	2.85	4.13	<0.001	0.003	0.808
	Speed	Yes	6.80	3.83	5.06	4.68	0.076		
	Amphetamine, metamphetamine, amphetaminsulphate (e.g., dexedrine, benzedrine)	Yes	6.21	2.52	2.22	3.22	0.002	0.012	0.764
	Ecstasy, MDMA	Yes	10.36	4.63	2.53	5.40	<0.001	<0.001	0.102
Last 12 months	At least one consumption of an illegal substance	Yes	9.76	5.72	5.06	6.42	0.018	0.023	0.656
	Hallucinogens, magic mushrooms, psilocybin, peyote, mescaline	Yes	5.04	2.41	2.22	2.91	0.032	0.055	0.843
	Other hallucinogens (LSD, PCP/Angel dust, 2-CB, 2-CI)	Yes	4.14	1.91	2.22	2.43	0.068		
	Speed	Yes	2.97	2.31	3.48	2.67	0.497		
	Amphetamine, metamphetamine, amphetaminsulphate (e.g., dexedrine, benzedrine)	Yes	3.55	1.51	0.95	1.82	0.023	0.026	0.458
	Ecstasy, MDMA	Yes	7.10	2.81	1.90	3.52	<0.001	0.001	0.372

once by more members of the high group than of the other two groups.

Concerning the second and third hypotheses, consumption in the high group of all substances, except alcohol and smokeless tobacco, during the last 12 months was overall lower than or equal to that in the low and medium groups. For alcohol, the level of consumption in the high group fell between that of the two other groups, while for smokeless tobacco the high group systematically consumed more than the other two groups. This last finding confirms the third hypothesis.

The consumption of substances affects all individuals, regardless of their level of physical activity. For instance, alcohol consumption is almost the same across the three groups. This contradicts the idea that people with a high level of physical activity, and especially elite athletes, avoid substance use. Thus, even the most athletic people might be at risk of addiction, and so they should receive particular attention in prevention policies. In the high group, the prevalence of consumption is very significant for some substances and modest for others. Consistent with the literature [14, 22], and especially with a study of 1,138 young German athletes [16], alcohol was the most consumed substance in the high group.

Regarding tobacco and cannabis, a statistically significant difference in lifetime prevalence of consumption between different levels of physical activity was found. Our findings confirm those of studies on young people in Greece [31], Germany [16] and the United States [32, 33]. Overall, the high group are less likely to consume smoked tobacco, but this is in part compensated by a higher level of consumption of smokeless tobacco products such as snuff and snus, as has also been found in previous studies [16, 21, 22]. This can be explained by awareness of the harmful nature of tobacco smoke on physical performance and on health in general [22], which could in turn explain the attractiveness of smokeless tobacco. However, these explanations are only partial, since most users of smokeless tobacco in the high group also consume smoked tobacco. The overall consumption level of other illicit substances and non-prescribed drugs is lower than for other substances, especially among the high group.

The main strengths of this study are that it is one of the first to specifically consider differences in substance use as a function of level of physical activity, that we included a large number of substances, and that we considered different consumption modes for tobacco and cannabis. However, a number of limitations must also be stressed. First of all, although the C-SURF study gives access to a very large sample, it concerns only male Swiss citizens. More-

over, even if the questionnaire was not answered during the recruitment, but at home a few days after, the military context, with its strict rules, could have influenced the way some people answered sensitive questions such as the ones related to substance use. Unfortunately, we do not have a way to measure the extent of this possible bias. Demographic characteristics were significantly different across the three levels of physical activity. Members of the high group were younger, had a lower level of education, and came mainly from the German part of the country. Therefore, the results are not fully generalisable, but this is not crucial, since our main objective was to compare the different physical activity level groups, not to obtain population prevalence figures. Indeed, as stated by Moore and colleagues [21], substance use can differ as a function of gender and the type of physical activity. This is in line with the findings of Henchoz and colleagues [34], who concluded that demographic characteristics can be considered determinants of physical activity in young people. Additional research is therefore required.

Detailed information regarding the sports and other physical activities practised was not available, so we had to rely on a combination of three different variables to define our physical activity level groups. Since the question regarding the regularity of physical activity during the last 12 months was also available in the two follow-ups of the C-SURF study, it would have been useful to have been able to incorporate it into the definitions of the groups in order to better identify people with high long-term physical activity levels, but the large amount of missing data in the two follow-ups meant we were not able to do so. Moreover, less than half of the recruits answered the baseline questionnaire, so selection bias is possible, although the design of our study, based on the comparison of three well-defined groups, limits this issue. In addition, item-level missing data were present in the database, so the final sample for this study was much smaller than the initial sample, and data from the two follow-ups could not be included. This decrease in the sample size is also due to our requirement for a very precise definition of the three physical activity level groups, but given the study objectives, it was essential to work with well-defined, homogeneous groups. Finally, the literature suggests that specific substance use behaviours could be related to specific sports, such as the consumption of snus among hockey players [22]. That could explain some results, but we were unable to investigate this further, since the sports practised by the respondents were not available in the C-SURF database.

Table 8: Consumption of prescribed drugs without medical prescription by level of physical activity.

Question	Category	Level of physical activity			Overall	p-value	Post hoc test	
		Low (1)	Medium (2)	High (3)			1 vs 3	2 vs 3
Last 12 months: at least one consumption of prescribed drugs without prescription	Yes	12.13	10.25	12.38	11.04	0.446		
Sleeping pills	Yes	5.03	2.71	3.17	3.28	0.117		
Tranquilizers	Yes	5.92	2.81	1.90	3.28	0.007	0.009	0.376
Strong painkillers	Yes	6.53	5.73	7.01	6.14	0.674		
Stimulants and amphetamine	Yes	3.55	1.31	1.90	1.88	0.032	0.199	0.440
Antidepressants	Yes	2.67	0.40	0.64	0.91	0.001	0.044	0.591
Anabolic steroids	Yes	1.19	0.50	2.56	1.04	0.007	0.197	0.001

Conclusion

Whatever their level of physical activity, adolescents and young adults are confronted with substances. Given the fact that adolescence is known as a period of experimentation, it is not surprising to see that the behaviour of people practising physical activity at a high level does not differ fundamentally from that of less active people. However, clear differences do appear when we look more specifically at the level of consumption and at the types of substances consumed. These differences call for a more specific approach towards substance consumption among athletes, and the creation of specific messages and campaigns directed at elite athletes and other people with high levels of physical activity. They must be reminded that many substances are prohibited, and that even those which are allowed (such as alcohol and tobacco) can negatively affect their performances in the short and the long term, as well as have possible consequences for their general health status.

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Potential competing interests

No potential conflicts of interest relevant to this article were reported.

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