Marijuana Consumption, Educational Outcomes and Labor Market Success: Evidence from Switzerland

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Abstract

In this paper, we analyze the impact of marijuana consumption during various periods in youth on educational outcomes and labor market success using a Swiss data set. Our findings seem to suggest that earlier marijuana consumption (i.e. before age 16) has indeed a statistically significant negative impact on educational success, but not on employment status when we control for educational background. In order to deal with possble endogeneity issues, we plan to instrument the consumption of marijuana using Canton-level data on the availability of the drug, measured as the number of drug trafficking delicts per capita.
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1 Motivation

Binge drinking among youths has become a common phenomenon in many countries, as well as consumption of marijuana, hallucinogens and other drugs. According to the European School Survey Project on Alcohol and Other Drugs[1], about 21% of 16-year-old students in nearly 40 European countries in 2003 had consumed cannabis at some point in their life. In Switzerland, the lifetime prevalence for the same age group was even 40 % in the same year. The short-term effects of risky behavior such as hangovers and drug-related accidents are immediately clear, but there also exists evidence on the long-term consequences of risky behavior. Medical research has shown adverse effects of regular and prolonged marijuana and alcohol consumption on cognitive ability, especially on mnemonic and concentration ability. Economic research on risky behavior of youths has shown that at least some risky behaviors translate into lasting negative impacts on human capital accumulation of individuals.

Existing economic research in the field focuses in most cases on consumption of one drug (e.g., alcohol or marijuana) and relatively short-term consequences for outcomes. The aim of our paper is an empirical analysis of the relationship between risky behaviors (alcohol, nicotine, drug consumption and other forms of individual risk-taking), educational outcomes, and labor market success. Hence, the general topic is individuals' incentives to invest in their human capital, and their ability to reap the benefits from their investments. The innovations of this research project are that we plan to use a theoretical foundation for the analysis, take into account different kinds of risky behaviors and also take a longer-term perspective with respect to outcomes. In addition, we analyze a broader sample of the population and not only high school or college students using a Swiss data set. As yet, most evidence on the topic stems from U.S. data, and there is nearly no evidence on risky behavior using European data sets. In addition, the existing literature tries in most cases to analyze the impact of one risky behavior at any point in time on educational outcomes. In contrast, we explicitly focus on critical and sensitive periods for the development of human capabilities and resulting educational success for the individual. We also plan to analyze in more detail the interactions of various risky behaviors in the next research step.

Up to now, the theoretical literature on human capital investments either followed an education economic (Becker 1962, Ben-Porath 1967) or a health economic (Grossman 1972) point of view. The two types of models have

[1] www.espad.org

different implications for an individual's stock of human capital: while investments in education increase individual productivity, health investments increase the amount of time available for production. In a recent paper, James Heckman (2007) proposed a synthesis of the two distinct literatures on health and education economics and developed a lifetime model of investment in human capital. In his model, altruistic parents invest into their offspring's capabilities (i.e. cognitive and non-cognitive skills, and health). The model features various characteristics that capture insights from neurological and medical research on the development of human capabilities. Heckman's model allows for the identification of critical and sensible periods during the development of human capabilities. We want to test if there are indeed these periods with respect to educational outcomes and labour market success (i.e., if there are more or less detrimental periods with respect to timing of initiation, duration, and intensity of drug consumption). In the analysis, we also take into account consumption of other drugs and other possible sources of unobserved heterogeneity by using information on respondents' mental stability and other characteristics.

For the empirical analysis, we use a unique Swiss data set, the Swiss Health Survey (Schweizerische Gesundheitsbefragung), a representative sample of the Swiss resident population. It contains very rich information on individuals' health-related attitudes, behaviors, health status, region of residence etc., but also on their educational attainment, professional status and personal income. In addition, there are items on respondents' psychological health status, e.g. with respect to their locus of control or depressions. Hence, the data set is very appropriate for an analysis of our research question.

Preliminary estimation results seem to suggest that there are indeed sensitive periods with respect to the impact of drug initiation on educational success. Estimation results from an ordered probit model show that marijuana initiation under age 17 is significantly correlated with lower educational outcomes, while initiation after age 17 does not show a statistically significant impact. However, once we control for educational background, we do not find any statistically significant correlation between the age of marijuana initiation and individuals' employment status using probit regressions. In both estimations, we controlled for a host of background variables, but there is still the possibility that the results are biased due to endogeneity problems. In order to overcome these possible problems, we plan to use a new instrumental variable for marijuana consumption that measures the regional availability of the drug at the time when a respondent started to use it.

The remainder of our paper is organized as follows. Part 2 presents a brief literature review for results on various kinds of risky behavior. Part 3 introduces the data set and provides descriptive statistics, part 4 outlines our

estimation strategy and presents preliminary results, and part 5 concludes and sketches the next research steps in this project.

2 Literature Review

In the last few years, literature on the impact of various risky behaviors on the accumulation of human capital and on labor market outcomes of young adults has considerably increased. The newer studies also take into account possible biases of the results due to endogeneity problems and adresses these issues using different identification strategies. We start this literature review with the effects of alcohol consumption. DeSimone and Wolaver (2005) analyze the impact of alcohol consumption on grades in high school. Using the Youth Risk Behavior Survey and proxies for unobserved individual characteristics like risk and time preference and mental health, they find a significantly negative impact of alcohol consumption on grades. Not surprisingly, the negative effect of binge drinking (defined as having five or more alcoholic drinks within a few hours) they find is over twice as large than the effect for any alcohol consumption. Williams et al. (2003) use the Harvard School of Public Health's College Alcohol Study in order the estimate the effect of alcohol use on grades in college, using state-level alcohol prices as instruments. Although they find a small positive effect of drinking on grades, this effect is outweighed by a slightly larger negative effect via reduced hours of studying due to alcohol consumption.

On a closely related topic, the impact of drinking on high school dropout, Chatterji and DeSimone (2005) use the National Longitudinal Survey of Youth 1979 Young Adults and an instrumental variables approach in order to identify the causal effect of alcohol consumption. Their IV estimates show even larger negative coefficients than their OLS estimates and a significantly negative impact of both drinking and binge drinking on the probability of finishing high school.

With respect to early labor market outcomes of young adults, Chatterji and DeSimone (2006) analyze the impact of drinking while in 10th grade on wages and employment status. Using an OLS strategy because of the lack of convincing instruments, they find significantly positive wage effects for males and no effects for females. They conjecture that binge drinking is correlated with unobserved social skills that are remunerated by employers.

We continue with the literature on effects of smoking. Cook and Hutchinson (2006) analyze the effects of both smoking and driking in 11th grade on the probability of finishing high school. While they do not find an effect of drinking, they do find one of smoking and explain this finding by smoking as

a signal of "being off track" in school. Hence, peer effects, not interpersonal differences in time preference, seem to be the transmission channel for their findings. Levine et al. (1997) also use the NLSY and different fixed-effects methods (panel and siblings fixed effects) for their analysis of the effect of smoking on wages and find that smokers' wages are between 4 and 8 % lower than nonsmokers' wages.

We finish this brief survey with some earlier results on our topic of interest, the impact of marijuana consumption on educational success. Liccardo Pacula et al. (2003) use the National Education Longitudinal Study and a differences-in-differences approach and find that marijuana use in high school does not seem to have an impact on results in standardized test scores, except for the scores in mathematics. Register et al. (2001), however, use the NLSY and two-stage least sqares estimation and find that marijuana use as well as consumption of other drugs reduce educational attainment by about one year.

Van Ours and Wechsler (2007) use an Australian data set and two different identification approaches in order to assess the causal impact of the timing of marijuana initiation on educational attainment. Using both an instrumental variable and a duration model approach, they find that earlier initiation into cannabis use leads to a significant reduction of years of schooling, and that this effect is larger for females.

To sum up, the results seem to suggest that there are indeed adverse effects of early smoking and marijuana initiation on educational outcomes. For the case of alcohol and marijuana use, it seems to be the case that both drugs have adverse effects on the hippocampus of adolescents, a region of the brain that is related to mnemonic and learning abilities (see Lisdahl Medina et al. 2007 for more details). This finding could provide an explanation for the worse educational outcomes of teenage alcohol and marijuana users.

In the next section, we continue with a brief description of our data set and a few descriptive statistics.

3 The Data Set

Our empirical analysis is based on the 2002 Swiss Health Survey (Schweizerische Gesundheitsbefragung), a representative sample of the Swiss resident population. It is carried out every five years by the Swiss Federal Statistical Office in order to gain insights on the health status of Switzerland's population age 15 and older. Questions include the physical, mental and social health status; conditions of living, health-related behavior, but also items like repondents' level of education, employment and income and many more.

The survey consists of two parts, the first one being a computer-assisted telephone interview, the second one being a questionnaire that was sent out to participants of the phone interview. The total sample size is $n = 19{,}706$, but we used only respondents age 40 and under for our empirical analyses because the data for our instrumental variable are only available for this time period. Our restricted sample still consists of 7,209 individuals.
The following section provides a few interesting descriptive features of the data set. Complete summary statistics for the other variables of interest are provided in Appendix A.
The first table shows educational outcomes for the entire sample and for seven different regions of Switzerland. The composition of the regions is provided in Appendix A.

Table 1: Educational Outcomes

	entire sample	Lake Geneva	Espace Mittelland	Northwestern CH
not answered	0.25	0.52	0.21	0.31
school dropout	5.09	3.88	4.88	5.51
compulsory schooling	14.02	18.35	14.57	11.54
secondary school-based	7.6	7.75	7.68	6.65
secondary vocational	56.01	47.98	57.55	56.65
tertiary vocational	9.82	9.3	9.64	9.67
tertiary university	7.2	12.23	5.46	9.67
Total	7,209	1,161	1,887	962
	Zurich	Eastern CH	Central CH	Ticino
not answered	0.35	0.21	0	0.2
school dropout	5.1	6.19	5.55	4.71
compulsory schooling	11.42	15.42	10.85	14.55
secondary school-based	6.15	7.45	6.9	12.5
secondary vocational	55.18	58.13	59.97	55.12
tertiary vocational	11.78	9.44	11.19	7.17
tertiary university	10.02	3.15	5.55	5.74
Total	569	953	1,189	488

It is not surprising to see that there are more university graduates in urban regions where there are probably more jobs for highly skilled individuals. Espace Mittelland, where Berne as the capital is located, has the highest proportion, while Eastern Switzerland as a quite rural region has the lowest. The vast majority of all respondents in the sample has finished at least a secondary education, either school-based or in the vocational system. Only around 5 % of individuals have not finished compulsory schooling.
In the next table, three different employment statuses are displayed: employ-

ment, unemployment, and being not employed (e.g. because the respondent has not finished his education yet).

Table 2: Employment Status

	entire sample	Lake Geneva	Espace Mittelland	Northwestern CH
employed	78.07	77.69	77.53	79.83
unemployed	2.47	2.24	2.49	2.29
not employed	19.46	20	19.98	17.88
Total	7,209	1,161	1,887	962
	Zurich	Eastern CH	Central CH	Ticino
employed	82.43	78.38	78.64	70.49
unemployed	3.16	2.41	1.93	3.89
not employed	14.41	19.2	19.43	25.61
Total	569	953	1,189	488

Switzerland's unemployment rate during the time of this survey was extremely low. Nevertheless, there are some regional differences, with the region of Ticino having the highest unemployment rate and central Switzerland the lowest.
The following table shows the percentages of individuals who have consumed marijuana at some point in their life in entire Switzerland and in the different regions. Again, there are remarkable differences across the regions. With 34.8% of all individuals, the canton of Zurich has the highest percentage of marijuana lifetime prevalence nationwide, while the canton of Ticino has the lowest (14.55%). The nationwide percentage of lifetime prevalence of marijuana consumption is 28.05%.

Table 3: Marijuana: Lifetime Prevalence

	entire	Lake Geneva	Espace Mittelland	Northwestern CH
never	71.48	65.46	71.07	66.84
not answered	0.04	0.17	0	0
yes	28.05	33.85	28.67	32.54
no (but other drugs)	0.43	0.52	0.26	0.62
	zurich	Eastern CH	Central CH	Ticino
never	64.85	73.87	77.54	84.84
not answered	0	0.1	0	0
yes	34.8	25.81	21.87	14.55
no (but other drugs)	0.35	0.21	0.59	0.61

As the focus of our paper is on the impact of the age of marijuana initiation on educational outcomes and labor market success, we also provide descriptive

statistics on the two outcomes of interest by the age of initiation.

Table 4: Educational Outcomes by Age of Marijuana Initiation

	under 12	13-14	15-16	17-18	19-20	over 21	entire sample	never-users
not answered	0	0	0.34	0	0	0	0.25	0.3
no education	0	16	4.75	1.95	0.3	0.84	5.09	5.96
compulsory schooling	54.55	36	16.98	9.61	4.56	7.53	14.02	14.93
secondary school	0	0	11.04	9.46	6.99	5.02	7.6	7.2
secondary vocational	27.27	28	52.29	59.46	60.49	56.49	56.01	55.89
tertiary vocational	18.18	16	8.66	9.01	14.89	17.15	9.82	9.36
tertiary university	0	4	5.94	10.51	12.77	12.97	7.2	6.36
n	11	25	589	666	329	239	7209	5,350

With respect to educational outcomes, it seems to be the case that earlier onset of marijuana consumption is related with less educational success. The percentage of individuals who have only finished compulsory schooling is much higher among the early users than in the entire sample. Also, the percentage of university graduates is highest among those who started to consume the drug aged 21 and older, and this percentage is even higher than the percentage of university graduates among the never-users of the drug.

Table 5: Employment Status by Age of Marijuana Initiation

	under12	13-14	15-16	17-18	19-20	over21	entire sample	never-users
not answered	0.00	0.00	0.17	0.00	0.00	0.00	0.01	0.00
employed	63.64	68.00	76.91	83.93	91.19	88.28	78.07	76.34
not employed	36.36	32.00	22.92	16.07	8.81	11.72	21.92	23.66
unemployed	9.09	4.00	4.24	3.30	2.74	1.67	2.47	2.13
n	11	25	589	666	329	239	7209	5,173

The table shows that respondents who reported an earlier onset of marijuana use are more likely to be not employed, which means that they can still be in training. However, unemployment rates are also much higher for individuals who started to use marijuana earlier in life. More than 9 % of the group who started younger than age 12 are unemployed, while only 1.6% of those who started age 21 and older are unemployed. At the same time, it should be kept in mind that sample sizes are very small for the individuals who started consumption before age 14.

In the next section, we turn to our estimation strategy and first empirical results.

4 Estimation Strategy and First Results

4.1 Method

As already mentioned in the motivation, it is quite likely that in fact both marijuana consumption and educational attainment are driven by unobserved characteristics such as time preference. In order to assess the causal impact of marijuana consumption of educational outcomes, we plan to use an instrumental variables estimation strategy.[2] In a first research step, we estimate ordered probit and probit equations and attempt to control for many unobservable characteristics using proxy variables.
Our preferred estimation equation is given by

$$outcome_{ij} = \beta_1 + \delta_1 m_i + \beta_2 x_i + \beta_3 x_j + u_{ij} \tag{1}$$

where m_i is our regressor of interest, namely, dummy variables for different ages of marijuana initiation, x_i denotes individual-specific characteristics and x_j is a vector of regional characteristics. Both x_i and $x_j$serve as control variables. u_{ij} is an error term that captures unobserved effects, and is possibly correlated within the regional groups. As we are interested in the effects of marijuana consumption on educational outcomes and labor market success, we estimate two different equations. We measure educational outcomes in six different categories (less than compulsory schooling/no answer; compulsory schooling, secondary vocational education, secondary school education, tertiary vocational education, tertiary university education). Hence, $outcome_{ij}$ is an ordered variable and we estimated our model using an ordered probit approach.
In our second estimation, we measure labor market success as an individual's employment status. Here, $outcome_{ij}$ is a binary variable that takes the value of 1 if the individual is unemployed and 0 else, and we use a probit model for estimation.

4.2 Selection and Construction of Variables

We used the unusual richness of our data set in order to find proxies for individuals' risk attitude and time preference. As proxies for individuals' degree

[2]At the moment, we are constructing the necessary instrumental variable, namely, Canton-level data on the availability of the drug, measured as the number of drug trafficking delicts per capita. The crucial assumption for this number being a valid instrument for marijuana consumption is that it needs to be uncorrelated with individual-level characteristics (e.g., time preference) that are possibly driving both educational and drug consumption decisions and that it needs to be correlated with individual-level marijuana consumption.

of risk aversion and time preference, we include information on an individuals' savings (controlling for age and income), on the self-reported importance of health, on respondents' health-related behavior, namely, their dental care and dietary habits, their body mass index and if they use sunscreen.[3] Following previous research, we include information on self-reported religiousness as a measure for the psychological costs of marijuana consumption that an individual occurs. We also control for various other impact factors that could influence educational outcomes, e.g., psychological stability, parents' citizenship, an indicator for being a Swiss citizen, the region of origin and the size of the respondents' municipality. We also use information on past consumption of other drugs and on the number of occasions that they were engaged in binge drinking activities (defined as having more than 6 or 8 alcoholic drinks on one occasion for females and males, respectively) in order to assess the true impact of marijuana consumption on educational outcomes.
Our regressors of interest in the estimations are dummy variables for the age when respondents started to smoke marijuana (under 12, between 13 and 14, between 15 and 16, between 17 and 18). We also have information on later onsets of marijuana use, but we do not use it in the empirical analysis. The reason is that most respondents in the sample have finished a secondary-level education that typically ends at age 18, hence, later onset of marijuana use should not have any impact on educational outcomes any more.

4.3 Preliminary Results

The following table presents results from ordered probit regressions, using the highest educational attainment of an individual as the dependent variable. Cluster-robust standard errors are given in parentheses (clustering on region of origin[4]). ***, **, and * denote significance levels of 1 %, 5%, and 10%, respectively. The regressions included controls for region of origin and the size of individuals' place of residence and for consumption of any other drugs at any point in life. In order to assess the stability of our results, we used three different specifications of our empirical model with different divisions of the age groups at which respondents started to smoke marijuana. We have restricted the sample to respondents who have indicated that they are not in full-time training anymore, meaning that they are likely to have completed their education. Complete estimation results including estimated coefficients on all control variables are provided in Appendix B.

[3]We plan to use more variables that could serve as proxies in the next research step.
[4]The results for clustering on municipality size show the same significance levels

Table 6: Educational Outcomes: Regression Results

	Model 1		Model 2		Model 3
marijuana under 12	-0.08				
	[0.488]				
marijuana 13-14	-0.664*	marijuana under 14	-0.459		
	[0.365]		[0.371]		
marijuana 15-16	-0.096**	marijuana 151-6	-0.096**	marijuana under 16	-0.111***
	[0.044]		[0.044]		[0.041]
marijuana 17-18	0.024	marijuana 17-18	0.024	marijuana 17-18	0.025
	[0.038]		[0.037]		[0.037]
age	0.063***	age	0.062***	age	0.063***
	[0.005]		[0.005]		[0.005]
female	-0.310***	female	-0.310***	female	-0.309***
	[0.021]		[0.021]		[0.021]
binges	0.055***	binges	0.055***	binges	0.055***
	[0.010]		[0.010]		[0.010]
BMI	-0.009**	BMI	-0.009**	BMI	-0.009**
	[0.004]		[0.004]		[0.004]
Mastery	0.061***	Mastery	0.062***	Mastery	0.062***
	[0.010]		[0.010]		[0.010]
Optimism	0.078***	Optimism	0.078***	Optimism	0.080***
	[0.025]		[0.025]		[0.026]
Religiousness	-0.037**	Religiousness	-0.037**	Religiousness	-0.037**
	[0.016]		[0.016]		[0.016]
Sunscreen use	-0.003	Sunscreen use	-0.003	Sunscreen use	-0.003
	[0.005]		[0.005]		[0.005]
Health importance	0.007	Health importance	0.007	Health importance	0.007
	[0.011]		[0.011]		[0.011]
Savings	2.933	Savings	2.93	Savings	2.906
	[5.638]		[5.641]		[5.659]
Nutrition	0.120***	Nutrition	0.120***	Nutrition	0.119***
	[0.040]		[0.040]		[0.040]
Swiss	0.281***	Swiss	0.281***	Swiss	0.282***
	[0.099]		[0.099]		[0.099]
Father Swiss	0.016	Father Swiss	0.016	Father Swiss	0.016
	[0.049]		[0.049]		[0.048]
Mother Swiss	-0.025	Mother Swiss	-0.027	Mother Swiss	-0.027
	[0.071]		[0.071]		[0.072]
n	5331		5331		5331
Pseudo R^2	0.0705		0.0704		0.0702
Log PseudoL	-6261.8214		-6262.4734		-6263.5437
Controls	Region	Municipality size	Other drugs		

The results seem to suggest that marijuana initiation under age 17 is indeed correlated with lower educational outcomes compared to the individuals who reported never having used marijuana. In contrast, onset of marijuana con-

sumption aged 17 and 18 does not show any significant impact on educational outcomes. It could be the case that the brain (and especially the hippocampus) is more vulnerable to the detrimental effects of cannabis during the earlier period, leading to worse learning abilities and - consequently - worse educational outcomes.

There are also some interesting results for the control variables. In our sample, female respondents are significantly less likely to end up with a higher educational outcome than males. This is a surprising result, and a closer look at the descriptive statistics reveals that more than 23 % of males have a tertiary education, but only 11.5% of all females in the sample. This difference is mainly driven by a much higher percentage of males with a tertiary vocational education, while the percentages of individuals with a tertiary university education are much closer together (8.5% for males and 6% for females). On the other hand, being Swiss is associated with significantly higher levels of education. Again, a look at the descriptive statistics reveals that this result is driven by a much higher percentage of Swiss citizens with secondary vocational training. However, approximately 15 % of both Swiss and Non-Swiss citizens have a tertiary education, but while 9 % of foreigners have a university degree, only around 7% of Swiss have one.

Both control variables for psychological stability, *mastery* as an index for one's locus of control and *optimism* for one's psychological well-being, show a statistically significant positive impact on educational outcomes, meaning that individuals who feel that they control their life and feel better have better educational outcomes. Also, respondents who indicated that they care about their diet are significantly more likely to end up with a better education, meaning that they probably care more about the future in every aspect of their life. The same holds true for the significantly negative correlation of body mass index with educational outcomes.

A variable for the number of binge drinking activities of an individual (*binges*) shows a statistically significant positive impact on educational outcomes. This result may be surprising at first sight, but it is not an unusual finding in the literature (see, for example, Williams et al. 2003). None of the other proxy variables shows a statistically significant impact on individual educational success.

However, even if we attempt to control for characteristics like time preference and risk attitude, there is still the possibility that these results are biased due to selection on unobservables. Therefore we plan to use an IV approach using data on the cantonal-level availability of marijuana as an instrument in a second research step.[5]

[5]At the moment, we are constructing the necessary variable.

In a second estimation, we look at labor market success, namely, individual employment status.[6] In the following table, we present results for a probit model where we calculated marginal effects. Cluster-robust standard errors are given in parentheses (clustering on region of origin). ***, **, and * denote significance levels of 1 %, 5%, and 10%, respectively. Complete estimation results including estimated coefficients on all control variables are provided in Appendix B.

Table 7: Employment Status: Regression Results

	Model 1		Model 2		Model 3
under12	0.07	under 14	0.005		
	[0.098]		[0.027]		
betw. 15-16	0.004	betw. 15-16	0.004	under 16	0.004
	[0.006]		[0.006]		[0.005]
betw. 17-18	0.001	betw. 17-18	0.001	betw. 17-18	0.001
	[0.002]		[0.002]		[0.002]
age	0.000	age	0.000	age	0.000
	[0.000]		[0.000]		[0.000]
female	0.006**	female	0.006**	female	0.006**
	[0.002]		[0.002]		[0.002]
binges	0.000	binges	0.000	binges	0.000
	[0.001]		[0.001]		[0.001]
bmi	0.000	bmi	0.000	bmi	0.000
	[0.001]		[0.001]		[0.001]
mastery	-0.001	mastery	-0.001	mastery	-0.001
	[0.001]		[0.001]		[0.001]
optimism	-0.005***	optimism	-0.005***	optimism	-0.005***
	[0.001]		[0.001]		[0.001]
swiss	-0.001	swiss	-0.002	swiss	-0.002
	[0.005]		[0.005]		[0.005]
fatherswiss	-0.004	fatherswiss	-0.004	fatherswiss	-0.004
	[0.007]		[0.007]		[0.007]
motherswiss	-0.003	motherswiss	-0.003	motherswiss	-0.003
	[0.004]		[0.004]		[0.004]
level of educ.	0.000	level of educ.	0.000	level of educ.	0.000
	[0.002]		[0.002]		[0.002]
n	5303		5315		5315
Log PseudoL	-451.64817		-451.64867		-451.2481
Controls	present drug cons.	past drug cons.			

The results seem to suggest that there are no adverse effects of earlier marijuana initiation on labor market success when controlling for education and

[6] At the moment, we attempt to construct hourly wages from the given information on household equivalent income in the data set, using the information on family structure, employment status and hours worked each week.

a host of other background variables, such as past and present consumption of other drugs. Interestingly, past cocaine consumption increases the probability of being unemployed significantly in all model specifications, while past ecstasy consumption shows a significant negative impact. We plan to explore these findings in more detail in a next research step, especially with respect to duration and intensity of consumption of the respective drugs and to possible interaction effects for past consumers of several drugs.

5 Conclusion and Outlook

The present paper provides a preliminary analysis of the impact of the age of marijuana initiation on educational outcomes and labor market success. We measured educational success in six different categories and labor market success as being employed or not. Following the concept of critical and sensitive periods for the development of human capabilities in a recent paper by Heckman (2007), we focused on different age periods of marijuana consumption onset. For the empirical analysis, we used the Swiss Health Survey 2002 (Schweizerische Gesundheitsbefragung), an unusually rich data set that combines information on educational background, health-related behavior and further individual- and regional-level background information. While we do find a statistically significant negative impact of marijuana initiation before age 16 on educational outcomes, we do not find any statistically significant impact on the probability of being employed once we control for educational background. These results are, however, still quite preliminary. They could add to the existing body of evidence on marijuana consumption indicating that the drug can indeed have detrimental effects on educational outcomes. At the same time, they could provide a further rationale for drug prevention programs for pupils and apprentices.

In the next research step, we plan to work woth an IV approach using an instrument for the cantonal-level availability of marijuana, measured as the number of trafficking delicts per capita at the age when an individual started using the drug. We also plan to analyze the impact of past marijuana consumption on hourly wages using the information on equivalent income, household structure, and weekly hours of work in order to calculate hourly wages. In addition, we want to further exploit the unusual richness of our data set in order to find possible proxy variables for otherwise unobserved characteristics. Finally, we want to analyze possible interaction effects of various risky behaviors and their impact on our outcomes of interest.

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A Descriptive Statistics

Table 8: Summary Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
marijuana under 12	0.0015	0.0390	0.0000	1.0000
marijuana betw. 13 and 14	0.0035	0.0588	0.0000	1.0000
marijuana betw. 15 and 16	0.0817	0.2739	0.0000	1.0000
marijuana betw. 17 and 18	0.0924	0.2896	0.0000	1.0000
marijuana betw. 19 and 20	0.0456	0.2087	0.0000	1.0000
marijuana over 21	0.0332	0.1790	0.0000	1.0000
age	30.5220	7.1717	15.0000	40.0000
female	0.5225	0.4995	0.0000	1.0000
binges	1.1050	1.0166	-9.0000	5.0000
tabac past	0.4900	0.4999	0.0000	1.0000
hero past	0.0100	0.0994	0.0000	1.0000
coca past	0.0344	0.1823	0.0000	1.0000
meta past	0.0024	0.0485	0.0000	1.0000
ecst past	0.0232	0.1504	0.0000	1.0000
amph past	0.0089	0.0938	0.0000	1.0000
halu past	0.0236	0.1517	0.0000	1.0000
stup past	0.0025	0.0499	0.0000	1.0000
tabac pres	0.3670	0.4820	0.0000	1.0000
hero pres	0.0006	0.0235	0.0000	1.0000
coca pres	0.0014	0.0372	0.0000	1.0000
meta pres	0.0004	0.0204	0.0000	1.0000
ecst pres	0.0014	0.0372	0.0000	1.0000
amph pres	0.0004	0.0204	0.0000	1.0000
halu pres	0.0021	0.0456	0.0000	1.0000
stup pres	0.0000	0.0000	0.0000	0.0000
bmi	22.8962	4.4266	-2.0000	106.2925
sunscreen use	0.7997	2.7161	-9.0000	1.0000
savings	-0.0002	0.0080	-0.1400	0.3789
nutrition	0.6517	0.5380	-9.0000	1.0000
swiss	0.8402	0.3664	0.0000	1.0000
father swiss	0.2980	2.0657	-9.0000	1.0000
mother swiss	0.3118	2.0640	-9.0000	1.0000

Table 9: Regional Composition

	Freq.	Percent	Cum.
Lake Geneva	1,161	16.1	16.1
Espace Mittelland	1,887	26.18	42.28
Northwest	962	13.34	55.62
Zurich	569	7.89	63.52
East	953	13.22	76.74
Central	1,189	16.49	93.23
Ticino	488	6.77	100
Total	7,209	100	

The regions are composed of the following cantons:
Lake Geneva: Vaud, Valais, Genéve
Espace Mittelland: Bern, Fribourg, Solothurn, Neuchâtel, Jura
Northwest: Basel-Stadt, Basel-Landschaft, Aargau
Zurich: Zurich
East: Glarus, Schaffhausen, Appenzell-Innerrhoden, Appenzell-Ausserrhoden, St. Gallen, Graubünden, Thurgau
Central: Luzern, Uri, Schwyz, Obwalden, Nidwalden, Zug
Ticino: Ticino

Table 10: Size of municipality of residence

	Freq.	Percent
more than 100,000	750	10.4
50000 - 999999	191	2.65
20000 - 49999	675	9.36
10000 - 19999	1,154	16.01
5000 - 9999	1,262	17.51
2000 - 4999	1,605	22.26
1000 - 1999	821	11.39
under 1000	751	10.42
Total	7,209	100

Table 11: Participation in religious events

	Freq.	Percent
not answered	21	0.29
nearly daily	51	0.71
once a week	457	6.34
twice a month	231	3.2
once a month	505	7.01
several times yearly	1,127	15.63
less often	1,539	21.35
never	3,278	45.47
Total	7,209	100

B Additional Estimation Results

Table 12: Labor Market Status: Full Regression Results

	Model 1		Model 2		Model 3
educ6	0.0000	educ6	0.0000	educ6	0.0000
	[0.002]		[0.002]		[0.002]
marijuana under12	0.0700	marijuana under14	0.0050		
	[0.098]		[0.027]		
marijuana 1516	0.0040	marijuana 1516	0.0040	marijuana under16	0.0040
	[0.006]		[0.006]		[0.005]
marijuana 1718	0.0010	marijuana 1718	0.0010	marijuana 1718	0.0010
	[0.002]		[0.002]		[0.002]
age	0.0000	age	0.0000	age	0.0000
	[0.000]		[0.000]		[0.000]
female	0.006**	female	0.006**	female	0.006**
	[0.002]		[0.002]		[0.002]
binges	0.0000	binges	0.0000	binges	0.0000
	[0.001]		[0.001]		[0.001]
tabac past	0.0010	tabac past	0.0010	tabac past	0.0010
	[0.005]		[0.005]		[0.005]
hero past	-0.0030	hero past	-0.0030	hero past	-0.0030
	[0.016]		[0.016]		[0.015]
coca past	0.016**	coca past	0.017**	coca past	0.017**
	[0.008]		[0.008]		[0.008]
meta past	-0.0010	meta past	-0.0050	meta past	-0.0050
	[0.019]		[0.014]		[0.013]
ecst past	-0.009**	ecst past	-0.009***	ecst past	-0.009***
	[0.004]		[0.003]		[0.003]
amph past	-0.010***	amph past	-0.0080	amph past	-0.0080
	[0.003]		[0.006]		[0.007]
halu past	0.019*	halu past	0.018*	halu past	0.018*
	[0.011]		[0.010]		[0.010]
stup past	0.0390	stup past	0.0260	stup past	0.0260
	[0.067]		[0.054]		[0.055]
tabac pres	0.0100	tabac pres	0.0100	tabac pres	0.0100
	[0.008]		[0.008]		[0.008]
hero pres	0.0210	hero pres	0.0540	hero pres	0.0550
	[0.065]		[0.109]		[0.097]
coca pres	0.0360	coca pres	0.0340	coca pres	0.0340
	[0.085]		[0.081]		[0.081]
ecst pres	0.1770	ecst pres	0.1520	ecst pres	0.1510
	[0.151]		[0.136]		[0.141]
bmi	0.0000	bmi	0.0000	bmi	0.0000
	[0.001]		[0.001]		[0.001]
mastery	-0.0010	mastery	-0.0010	mastery	-0.0010
	[0.001]		[0.001]		[0.001]
optimism	-0.005***	optimism	-0.005***	optimism	-0.005***
	[0.001]		[0.001]		[0.001]

	Model 1		Model 2		Model 3
swiss	-0.0010	swiss	-0.0020	swiss	-0.0020
	[0.005]		[0.005]		[0.005]
father swiss	-0.0040	father swiss	-0.0040	father swiss	-0.0040
	[0.007]		[0.007]		[0.007]
mother swiss	-0.0030	mother swiss	-0.0030	mother swiss	-0.0030
	[0.004]		[0.004]		[0.004]
leman	-0.0020	leman	-0.0020	leman	-0.0020
	[0.002]		[0.002]		[0.002]
mittelland	0.0020	mittelland	0.0010	mittelland	0.0010
	[0.002]		[0.002]		[0.002]
northwest	-0.005***	northwest	-0.005***	northwest	-0.005***
	[0.001]		[0.001]		[0.001]
zueri	-0.0030	zueri	-0.0030	zueri	-0.0030
	[0.002]		[0.002]		[0.002]
east	0.0000	east	0.0000	east	0.0000
	[0.001]		[0.001]		[0.001]
ticino	0.022***	ticino	0.023***	ticino	0.023***
	[0.005]		[0.005]		[0.005]
under 1000	-0.008*	under 1000	-0.008**	under 1000	-0.008**
	[0.005]		[0.003]		[0.003]
1000-1999	-0.011***	1000-1999	-0.011***	1000-1999	-0.011***
	[0.003]		[0.001]		[0.001]
2000-4999	-0.009**	2000-4999	-0.009***	2000-4999	-0.009***
	[0.005]		[0.003]		[0.003]
5000-9999	-0.0070	5000-9999	-0.007***	5000-9999	-0.007***
	[0.005]		[0.003]		[0.003]
10000-19999	-0.0050	10000-19999	-0.005**	10000-19999	-0.005**
	[0.006]		[0.002]		[0.002]
20000-49999	-0.008**	20000-49999	-0.007**	20000-49999	-0.007**
	[0.004]		[0.003]		[0.003]
over100000	0.0000	50000-99999	0.0000	50000-99999	0.0000
	[0.006]		[0.006]		[0.006]
Observations	5303	Observations	5315	Observations	5315

Cluster-robust standard errors are given in parentheses (clustering on region of origin). ***, **, and * denote significance levels of 1 %, 5%, and 10%, respectively.

Table 13: Educational Outcomes: Full Regression Results

	Model 1		Model 2		Model 3
under12	-0.08				
	[0.488]				
13-14	-0.664*	under 14	-0.459		
	[0.365]		[0.371]		
15-16	-0.096**	15-16	-0.096**	under16	-0.111***
	[0.044]		[0.044]		[0.041]
17-18	0.024	17-18	0.024	17-18	0.025
	[0.038]		[0.037]		[0.037]
age	0.063***	age	0.062***	age	0.063***
	[0.005]		[0.005]		[0.005]
female	-0.310***	female	-0.310***	female	-0.309***
	[0.021]		[0.021]		[0.021]
binges	0.055***	binges	0.055***	binges	0.055***
	[0.010]		[0.010]		[0.010]
tabacpast	0.019	tabacpast	0.02	tabacpast	0.02
	[0.048]		[0.048]		[0.049]
heropast	0.379	heropast	0.376	heropast	0.376
	[0.258]		[0.259]		[0.259]
cocapast	0.036	cocapast	0.038	cocapast	0.039
	[0.083]		[0.082]		[0.083]
metapast	0.006	metapast	-0.005	metapast	-0.015
	[0.320]		[0.317]		[0.318]
ecstpast	-0.019	ecstpast	-0.008	ecstpast	0.012
	[0.072]		[0.075]		[0.082]
amphpast	0.273*	amphpast	0.24	amphpast	0.225
	[0.142]		[0.147]		[0.161]
halupast	0.041	halupast	0.038	halupast	0.034
	[0.090]		[0.090]		[0.093]
stuppast	-0.571*	stuppast	-0.550*	stuppast	-0.524*
	[0.297]		[0.306]		[0.302]
bmi	-0.009**	bmi	-0.009**	bmi	-0.009**
	[0.004]		[0.004]		[0.004]
mastery	0.061***	mastery	0.062***	mastery	0.062***
	[0.010]		[0.010]		[0.010]
optimism	0.078***	optimism	0.078***	optimism	0.080***
	[0.025]		[0.025]		[0.026]
religiousness	-0.037**	religiousness	-0.037**	religiousness	-0.037**
	[0.016]		[0.016]		[0.016]

	Model 1		Model 2		Model 3
sunscreen use	-0.003	sunscreen use	-0.003	sunscreen use	-0.003
	[0.005]		[0.005]		[0.005]
health importance	0.007	health importance	0.007	health importance	0.007
	[0.011]		[0.011]		[0.011]
savings corrected	2.933	savings corrected	2.93	savings corrected	2.906
	[5.638]		[5.641]		[5.659]
nutrition	0.120***	nutrition	0.120***	nutrition	0.119***
	[0.040]		[0.040]		[0.040]
swiss	0.281***	swiss	0.281***	swiss	0.282***
	[0.099]		[0.099]		[0.099]
father swiss	0.016	father swiss	0.016	father swiss	0.016
	[0.049]		[0.049]		[0.048]
mother swiss	-0.025	mother swiss	-0.027	mother swiss	-0.027
	[0.071]		[0.071]		[0.072]
leman	0.130***	leman	0.129***	leman	0.129***
	[0.031]		[0.030]		[0.030]
mittelland	0.008	mittelland	0.007	mittelland	0.008
	[0.009]		[0.009]		[0.009]
northwest	0.021	northwest	0.021	northwest	0.02
	[0.033]		[0.033]		[0.033]
zurich	0.01	zurich	0.01	zurich	0.01
	[0.035]		[0.035]		[0.035]
east	-0.109***	east	-0.109***	east	-0.108***
	[0.004]		[0.004]		[0.004]
ticino	-0.105***	ticino	-0.104***	ticino	-0.104***
	[0.019]		[0.019]		[0.019]
under 1000	-0.261***	under 1000	-0.261***	under 1000	-0.262***
	[0.056]		[0.057]		[0.056]
1000-1999	-0.202***	1000-1999	-0.202***	1000-1999	-0.203***
	[0.056]		[0.056]		[0.056]
2000-4999	-0.243***	2000-4999	-0.243***	2000-4999	-0.245***
	[0.044]		[0.044]		[0.044]
5000-9999	-0.175***	5000-9999	-0.174***	5000-9999	-0.175***
	[0.061]		[0.061]		[0.061]
10000-19999	-0.091**	10000-19999	-0.090**	10000-19999	-0.093**
	[0.039]		[0.039]		[0.040]
20000-49999	-0.02	20000-49999	-0.018	20000-49999	-0.02
	[0.059]		[0.059]		[0.060]
over 100000	0.126	over 100000	0.127	over 100000	0.126
	[0.091]		[0.091]		[0.094]
n	5331		5331		5331

Cluster-robust standard errors are given in parentheses (clustering on region of origin).
***, **, and * denote significance levels of 1 %, 5%, and 10%, respectively.