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ORIGINAL ARTICLE

Poor nutrition and substance use in a Swiss cohort of adults with spinal cord injury

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Abstract
Objectives To describe associations and co-occurrence of nutrition and substance use in Swiss residents with spinal cord injury (SCI) and to compare prevalence with a matched general population sample.
Methods Analysis of cross-sectional data (n=511) from the Swiss SCI community survey (SwiSCI) including Swiss residents with SCI aged over 16. Regression models were computed to assess associations of age, sex, socioeconomic position, social support, and self-efficacy with nutrition (liquid, fruit, vegetable, and meat intake), smoking, alcohol and cannabis consumption. Co-occurrence was evaluated by residual correlations of multivariable models.
Results Age differences in smoking, alcohol and cannabis consumption, and sex differences in nutrition and alcohol consumptionwere identified. Socioeconomic position, social support and self-efficacy were not associated with nutrition and substance use. Poor nutrition was related to higher alcohol consumption and most substance use behaviors co-occurred. Compared to the general population, persons with SCI reported higher liquid and cannabis intake but lower alcohol and meat consumption.
Conclusion In this population with severe disability, age and sex differences in nutrition and substance use should be considered in health intervention planning.

Keywords Nutrition · Alcohol consumption · Smoking · Cannabis smoking · Spinal cord injury

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Introduction

Poor nutrition, smoking and alcohol consumption are key determinants of morbidity and premature mortality (Chiuve et al. 2011; Stringhini et al. 2010). In the general population, nutrition and substance use vary according to sociodemographic characteristics, dispositional traits, and circumstances of the proximal social environment. For instance, age and sex (Fekete et al. 2012; Gmel et al. 2013; Swiss Statistics 2012), self-efficacy and locus of control (AbuSabha and Achterberg 1997), social network and support (Weyers et al. 2010), or socioeconomic position (Huisman et al. 2005; Lantz et al. 1998) have been linked to health behaviors. Furthermore, it has been demonstrated that poor nutrition and substance use are not isolated behaviors, but interrelate in a distinct patterned health-related lifestyle. For example, smokers reported higher alcohol consumption and poorer nutrition compared to non-smokers (Ma et al. 2000; Muff et al. 2010).

In this exploratory study, we set out to investigate associated factors of nutrition and substance use (smoking, alcohol and cannabis consumption) among adults with a severe physical impairment, namely spinal cord injury (SCI). SCI has a far-reaching impact on a person's functioning and health because affected persons suffer from a loss of sensory and motor function below the lesion level (Bickenbach et al. 2013). Because persons with a disability such as SCI are challenged with a lifelong heightened risk of secondary health conditions (Jensen et al. 2013) and premature mortality (Strauss et al. 2006),

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healthy nutrition, moderate alcohol consumption and non-smoking are of utmost importance for health maintainance in this vulnerable group (Krause and Saunders 2010). Physical activity as further important health behavior is excluded from analysis as this issue is particularly complex in a population with physical impairment and needs therefore special discussion.

Despite far-reaching public health interventions and the increased susceptibility to develop health problems, adverse health behaviors are prevalent in the SCI population. The few studies on nutrition in community-dwelling persons with SCI show that the intake of fat, dietary fibre, several vitamins, minerals, and macronutrients did not meet recommended levels or were excessively low (Levine et al. 1992; Moussavi et al. 2001; Tomey et al. 2005). Smoking has been named the most damaging lifestyle behavior in the SCI population as it enhances the risk for morbidity more robustly than any other behavior (Davies and McColl 2002). Still, smoking rates in persons with SCI are above 20 % (Johnston et al. 2005; Stolzmann et al. 2010), indicating higher prevalence than in the general population (Johnston et al. 2005). In addition, a considerable proportion of persons with SCI consume problematic amounts of alcohol and cannabis. Tate et al. (2004) have identified 14 % of a sample of 3,041 persons with SCI as problematic drinkers. Due to its pain- and spasticity-reducing effect, regular cannabis consumption seems also widespread in persons with SCI (Hwang et al. 2012, prevalence 11 %; Young et al. 1995, prevalence 16 %). Reported figures on nutrition and substance use for SCI may not be generalizable to other contexts as behaviors may be influenced by cultural norms, customs, and public health policies (Mladovsky et al. 2009). To date, population-based data on nutrition and substance use in Swiss residents with SCI were not available and only few studies investigated associated factors and the co-occurrence of poor nutrition and substance use in people with SCI. Furthermore, the comparison of prevalence with matched general population samples is widely lacking.

The objectives of this study were (1) to describe nutritional status and prevalence of substance use (smoking, alcohol and cannabis consumption) in SCI and to compare it with a matched sample of the Swiss general population, (2) to investigate the association of age, sex, socioeconomic position, social support, and general self-efficacy with nutritional status and substance use in SCI, and (3) to assess the co-occurrence of poor nutritional status and substance use in SCI.

Methods

Sample

We analyzed cross-sectional data from the population-based community survey of the Swiss Spinal Cord Injury Cohort Study (SwiSCI) (Post et al. 2011). The survey was conducted between late 2011 and early 2013 and included persons with traumatic or non-traumatic SCI aged over 16 years at study residing in Switzerland. Exclusion criteria were defined by a team of SCI experts. Persons with new SCI in the context of palliative care, with neurodegenerative disorders, and with Guillain-Barré syndrome were excluded from the study. Persons with congenital conditions leading to SCI were also excluded as those persons mainly follow other rehabilitation processes than persons who get injured later in life. Persons with congenital conditions are therefore atypical cases with limited comparability to other study subjects. The SwiSCI population was recruited through the national association for persons with SCI, three specialized SCI-rehabilitation centers, and a SCI-specific home-care institution.

The SwiSCI survey contained three subsequent modules that were sent out with an interval of about 3 months: (1) the Starter Module, a brief questionnaire on basic socio-demographics, lesion characteristics and the care situation; (2) the Basic Module, comprising detailed information on functioning, health, environmental and personal factors; and (3) three thematically different specific modules including the Health Behavior and Personal Factors (HBPF) Module, the Work Module, and the Health Services Research Module (Post et al. 2011). In order to reduce participant's burden, participants of the Basic Module were randomly assigned to one of the three specific modules. Therefore, data on nutrition and substance use was only collected in the subsample of 511 persons who were assigned to the HBPF Module.

In total, 3,144 persons were eligible for the survey and response rates were at 61.1, 49.3 and 42.6 % for the first, the second and the third modules respectively. All modules were assessed as written or online questionnaires, and in special cases, by telephone interview. This study has been approved by the Medical Ethical Committee of the Canton Lucerne, Switzerland, and all participants have signed a written consent form (Post et al. 2011).

To compare nutrition and substance use with the general population, data from the Swiss Health Survey (SHS) 2012 were used. The SHS samples basic information on the health state, health behavior and health service use in the Swiss population. Since 1992, the SHS is carried out every 5 years and is part of the data collection program of the Swiss population census since 2010. From an initial 41,008 persons randomly selected from the sample frame for person and household surveys, a total of 11,314 females and 10,283 males participated in the SHS 2012 (response rate 54 %; Federal Statistical Office 2013).

Measures

Socioeconomic position Socioeconomic position (SEP) was classified in four categories including information on years of formal education (UNESCO 1997), net equivalence household income (Hagenaars et al. 1994), and an item on

subjective evaluation of financial difficulties (none, some, many difficulties). We built a sum score according to the following coding scheme: Education below average = 0; education above average = 1; income below average = 0; income above average = 1; having some or many financial difficulties = 0; having no financial difficulties = 1. Sum scores of 0 were classified as low SEP, 1 as low to middle SEP, 2 as middle to high SEP and 3 as high SEP. We conducted sensitivity analyses to test whether the use of a combined SEP indicator (sum score including information on education, income and financial difficulties) does not deliver other results than the use of single SEP indicators (education, income and financial difficulties separately). The results of the sensitivity analyses revealed that associations of SEP with nutrition and substance use did not differ between scenarios. Missing information on education (n=11) was recoded by using free-text information on highest educational degree. In four cases with completely missing information on education, missing values were replaced by the sample mean for matching with the SHS population.

Social support We used information on partner status (having a partner/no partner) and living arrangement (alone/with others) as indicators for social integration. We combined this information into a dichotomous variable for all analyses (having a partner and living with others vs. no partner or living alone/having a partner and living alone). Social support was assessed with the Social Support Questionnaire including information on the number of supportive persons (0–9) and satisfaction with the received support (6-point scale ranging from 1=very dissatisfied to 5=very satisfied; Sarason et al. 1983). A continuous variable on mean number of supportive persons and satisfaction with support was used for multivariable analyses. For cross-tabulations, tertiles upon the total scores were built.

General self-efficacy General self-efficacy was assessed using the General Self-efficacy (GSE) Scale containing 10 four-point Likert-scaled items (Schwarzer and Jerusalem 1995). The total score ranges from 10 to 40 with higher scores indicating higher self-efficacy. The total GSE score was used as continuous variable in multivariable analyses, for bivariate analyses, distribution-based tertiles were built.

Nutrition Participants in the SwiSCI study and the SHS were asked about their liquid intake (deciliters/day, excluding alcoholic beverages), fruit and vegetable intake (portions/day, 1 item on fruit, 1 item on vegetable intake: <1, 1–2, 3–4, ≥5) and meat/sausage intake (days/week: never, ≤1, 2–3, 4–5, 6, daily). This information on nutrition was then scored according to current nutritional recommendations (Deutsche Gesellschaft für Ernährung 2013) to derive a crude assessment of nutrition quality (scoring: 0=against recommendations; 1=acceptable; 2=recommended; Winkler and Döring 1995). Daily liquid intake was scored as <1.0 L=0, 1.0–1.49 L=1, and ≥1.5 L=2 (Deutsche Gesellschaft für Ernährung 2013). To assess fruit and vegetable consumption, a sum score of the two variables was built (range 0–6). Poor consumption included sum scores from 0 to1 (≤2 portions/day=0), moderate consumption a sum score of 2 (3–4 portions/day=1), and recommended consumption sum scores ≥3 (≥5 portions/day=2; Deutsche Gesellschaft für Ernährung 2013). Meat consumption was scored as follows: less than once/week=1, 2–3 days/week=2, and ≥4 days/week=0. For analyses, we summed up the three scores (liquid, fruit and vegetable, meat intake) to an overall nutrition score ranging from 0 to 6 with higher scores indicating higher nutrition quality.

Smoking In the SwiSCI study and the SHS, smoking status was assessed using the categories current smoker, ex-smoker and never smoker. Smoking intensity was additionally assessed by gathering information on total years of smoking and mean amount of daily consumption of different tobacco products (cigarettes; cigars/cigarillos/cheroots; pipes/water pipes). Thereof, lifetime pack years were calculated by multiplying the number of daily smoked packs of tobacco products by the number of years smoked. Cigars/cigarillos/cheroots were weighted by factor 3 and pipes/water pipes by factor 3.5 as recommended by the Royal College of General Practitioners (http://smokingpackyears.com/calculate, accessed 15 April 2014). In the SHS, pack years were calculated for current smokers only as information on amount of tobacco products consumed has not been assessed in ex-smokers.

Alcohol consumption In both surveys, alcohol consumption was assessed using information on frequency (SwiSCI: less than monthly or never, 1–3 times/month, 1–3 times/week, 4–6 times/week, daily; SHS: less than once/month, once a month, 2–3 times/month, weekly, 1–2 times/week, 3–4 times/week, almost daily) and amount of drinks consumed per drinking occasion (1–2; 3–4; ≥5). Of this information, we computed daily grams of alcohol consumed by multiplying monthly consumption days by 11 (mean standard drink: approx. 11 g of pure alcohol). Binge-drinking occasions were assessed by asking participants about the frequency of drinking more than 4 (females) or 5 (males) alcoholic drinks in one occasion (less than monthly or never, 1–3 times/month, 1–3 times/week, 4–6 times/week, daily). Information on binge drinking was not comparable to the SHS data, as different cut-points to define binge drinking were used.

Cannabis consumption In the SwiSCI study, cannabis consumption was assessed with a single item on the consumption during the last 30 days (yes/no). To compare prevalence of cannabis consumption with the SHS population, information from the SHS on consumption frequency during the past 12 month was used (weekly or more, 1–3 times/month, less than once a month). Persons having used cannabis more than once a month were classified as consumers in the past 30 days.

Confounders Sociodemographic (German, Italian, French language region; Swiss nationality/others; paid employment/no paid employment) and lesion characteristics (para-/tetraplegia; complete/incomplete lesion; traumatic/non-traumatic aetiology; years since injury) were included as confounders in multivariable analyses.

Statistical analyses

Nutrition status and prevalence of substance use were described in the SwiSCI population in comparison with the Swiss general population. SwiSCI participants were matched with non-SCI participants from the SHS 2012 based on age, sex, years of education and language region with a matching ratio of 1:4 by using a multivariate genetic search algorithm implemented in the R package Matching (Sekhon 2011). Differences in nutrition and substance use between the SwiSCI and the SHS study populations were estimated using mixed effects linear or logistic models adjusted for the matching group via random effects. Bivariate associations between predictors and outcomes are presented using cross-tabulations and indicating *p* values of Kruskal-Wallis tests for continuous, and chi-square tests for categorical outcomes. Covariate-adjusted regression analyses were applied to evaluate associations between predictors and outcomes. For positive, right-skewed, continuous dependent variables with frequent values of zero (daily grams of alcohol, pack years), zero-inflated Poisson models (ZIP) were fitted to the data. In ordinal outcomes (nutrition score, binge-drinking occasions, smoking status), ordinal logit regressions were applied. Forcannabis use, ordinary logistic regressions were used. Group-wise *p* values were computed for the regression models using equal fraction-missing-information (FMI) tests (Li et al. 1991). To test for co-occurrence of health behaviors, the residuals of all multivariable adjusted models were computed and examined for mutual correlation by indicating Kendall's tau.

In the main data analyses, we controlled for both unit and item nonresponse (Yan and Curtin 2010). Unit nonresponse, which refers to the refusal to participate in the survey by an eligible person, was at 57.4 % for the HBPF Module used in this study (response rate 42.6 %). From the recruitment source, we had information on sex, age, lesion level and language region for all persons invited to the study. This information was used to compare the study participants to the total invited population, which is supposed to accurately represent the entire Swiss SCI population. To adjust estimates for unit nonresponse, we used inverse probability weights (IPWs) as sampling weights in regression and correlation analyses. IPWs were derived from propensity scores in multivariable-adjusted logistic regression analyses.

Item nonresponse, which refers to the failure of survey respondents to answer a specific question, was addressed using multiple imputation (MI). We used MI by chained equations (MICE) to impute different types of variables, including categorical, ordinal and linear variables (White et al. 2011). We imputed predictor and control variables, but only analysed full cases in outcomes. For each model, imputations for 10 datasets were carried out. In the respective table, odds ratios (ordinal and logit regressions), rate ratios (Poisson part of zero-inflated Poisson regressions) and 95 % confidence intervals are reported. STATA Version 13 for Windows (College Station, TX, USA) was used for main analyses and R 2.14.2 for the matching of the SwiSCI and the SHS database.

Results

The majority in the sample was male, mean age was 52.9 years and over 90 % of the sample held Swiss citizenship (see Table 1). Four out of 10 persons had paid employment

Table 1 Sociodemographic characteristics, socioeconomic position, social support, general self-efficacy and lesion characteristics of the SwiSCI study population

	Study population *N*=511
Sociodemographic characteristics	
Male, *n* (%)	371 (72.6)
Age in years, mean (SD)	52.9 (14.8)
Swiss citizenship, *n* (%)	458 (92.0)
Paid work, *n* (%)*	200 (40.7)
Language region, *n* (%)	
German	361 (70.7)
French	129 (25.2)
Italian	21 (4.1)
Socioeconomic position, *n* (%)**	
High	88 (19.5)
Middle to high	127 (28.1)
Low to middle	161 (35.6)
Low	76 (16.8)
Social support	
No partner or living alone, *n* (%)	197 (40.8)
Number of supportive persons* (scale 0–9), mean (SD)	2.9 (1.8)
Satisfaction with social support*** (scale 1–6), mean (SD)	5.3 (0.9)
General self-efficacy (scale 10–40), mean (SD)	30.3 (5.6)
Lesion characteristics	
Paraplegia, *n* (%)	350 (68.9)
Complete lesion, *n* (%)	222 (43.5)
Traumatic aetiology, *n* (%)	400 (78.6)
Years since injury, mean (SD)	17.6 (13.0)

Number of missing values: not marked<3.0 %; * 3.0–6.9 %; ** 7.0–11.6 %; *** 18.4 %

SwiSCI Swiss Spinal Cord Injury Cohort Study, *SD* standard deviation

and 7 out of 10 persons resided in the German-speaking part of Switzerland. SEP of around 20 % was classified as high and of 16 % as low. Around 60 % of persons indicated having a partner and living with others, mean number of supportive persons was around 3 and satisfaction with social support was rather high (5.3 on a 1–6 scale). On a scale ranging from 10 to 40, mean general self-efficacy was slightly above 30. Almost 70 % of the participants had a paraplegia, less than half had a complete lesion and in around 4 out of 5 persons, the SCI was caused by a traumatic event. Many persons in our sample have lived a long time with SCI as mean time since injury was above 17 years.

Objective 1: description of nutritional status and prevalence of substance use in SCI and general population comparison

On average, liquid intake of persons with SCI was higher and weekly days of meat consumption was somewhat lower than in the general population. On a total nutrition score (0–6), persons with SCI reached 0.45 points more than matched SHS participants. Alcohol consumption (g/day) was around two times higher in the general population. In contrast, cannabis consumption during the last 30 days was 5.7 times higher in the SCI population. Fruit and vegetable consumption, smoking status and pack years for smokers varied only marginally between the samples (Table 2).

Objective 2: association of age, sex, socioeconomic position, social support, and general self-efficacy with nutritional status and substance use in SCI

Bivariate associations with sex were significant in nutrition ($p<0.001$) and alcohol consumption (g/day, $p<0.001$; binge drinking, $p=0.020$) with females showing a healthier lifestyle. Older persons were less often current smokers ($p=0.002$) or cannabis consumers ($p<0.001$) but had accumulated more pack years ($p=0.029$). Older persons also reported higher alcohol consumption (g/day; $p=0.005$). Daily grams of alcohol were lowest in persons with lowest SEP compared to higher SEP groups, and lower in persons living alone/having no partner compared to those having a partner/living with others. In contrast, persons living alone/

Table 2 Nutrition and substance use in the SwiSCI study population and the matched population of the Swiss Health Survey 2012[a]

	Study population $N=511$	1:4 matched SHS population $N=2044$	Difference (confidence interval 95 %)[b]
Nutrition, mean (SD)			
Liquid intake in daily liters	2.02 (0.84)	1.66 (0.76)	0.36 (0.29–0.44)
Daily portions of fruit	1.44 (1.20)	1.32 (1.17)	0.11 (−0.00–0.22)
Daily portions of vegetables	1.46 (0.98)	1.58 (1.11)	−0.11 (−0.22–0.01)
Days of meat consumption per week	3.70 (1.56)	3.97 (1.63)	−0.28 (−0.43–0.12)
Nutrition score (0–6)	3.05 (1.45)	2.60 (1.48)	0.45 (0.30–0.59)
Smoking			
Current smoker, *n* (%)	125 (24.90)	506 (24.76)	0.16 (−3.78–4.60)
Ex-smoker, *n* (%)	145 (28.88)	587 (28.72)	0.25 (−3.96–4.92)
Never smoker, *n*(%)	232 (46.22)	951 (46.53)	−0.38 (−5.30–4.62)
Lifetime pack years, mean (SD)	10.40 (18.01)**	NA	NA
Lifetime pack years (only current smokers), mean (SD)	21.00 (21.77)*	21.57 (18.15)	0.56 (−3.12–4.25)
Alcohol consumption			
Daily grams of alcohol, mean (SD)	6.32 (8.82)	12.23 (16.63)	−5.93 (−7.38–4.48)
Binge drinking occasions, *n* (%)		NA	NA
Never	357 (71.98)		
1–3 times a month	94 (18.95)		
1–2 times a week	31 (6.25)		
v≥3 times a week	14 (2.82)		
Cannabis consumption, *n* (%)			
Cannabis consumption (last 30 days)	35 (6.96)	25 (1.22)	3.75 (1.90–6.83)

[a] Matching based on sex, age, language region, and years of formal education

[b] Difference (mean or % of study population) – (mean or % SHS population), adjusted for matching groups using random effects

Number of missing values: not marked <3.0 %; * 7.2 %; ** 11.2 %

SwiSCI Swiss Spinal Cord Injury Cohort Study, *SHS* Swiss Health Survey, *SD* standard deviation, *NA* not applicable for comparison

having no partner were more often smokers or cannabis consumers. Neither social support nor general self-efficacy were consistently associated with nutrition or substance use (Table 3).

After controlling for potential confounders, we found lower nutrition quality and higher alcohol consumption (g/day) in males compared to females (Table 4). Higher age was associated with lower smoking rates and lower cannabis consumption. Daily grams of alcohol increased significantly with age, as did pack years. SEP, social support and general self-efficacy were inconsistently related to nutrition and substance use (p values of FMI-test all above 0.05).

Objective 3: co-occurrence of poor nutritional status and substance use in SCI

We observed that persons with higher nutrition quality consume less alcohol (g/day), whereas other substance use behaviors were not related to nutrition (Table 5). Smoking status and pack years were associated to higher alcohol (g/day and binge drinking) and cannabis consumption. Higher intake of daily grams of alcohol went along with more binge drinking occasions and cannabis consumption, however, binge drinking and cannabis consumption were not related.

Discussion

Comparing nutrition and substance use in persons with SCI from Switzerland with the Swiss general population revealed higher non-alcoholic liquid and cannabis consumption and lower meat and alcohol consumption in persons with SCI, while smoking status, pack years for smokers and fruit and vegetable intake were identical to the Swiss general population. We found significant sex differences in nutrition and alcohol consumption, as well as age differences in four out of six studied health behaviors. Surprisingly, we could not observe variations in nutrition quality or substance use according to SEP, social support and general self-efficacy. We observed that persons with lower nutritional scores tend to consume more alcohol (expressed in grams per day) and found co-occurrence of most studied substance use behaviors.

The reduced alcohol consumption in SCI compared to the Swiss general population may be related to the fact that many persons with SCI suffer from secondary health conditions that require continuous medication. The recommendation not to combine drug and alcohol intake might play a role in cautious alcohol consumption in the SCI population. The elevated frequency of cannabis use in the SCI population compared to the general population might be explained by its pain- and spasticity-reducing effects as these health conditions are highly prevalent in SCI populations.

In line with our findings, sex differences in nutrition and alcohol consumption have been observed in the Swiss general population (Swiss Statistics 2012) as well as in SCI populations (Moussavi et al. 2001; Tate et al. 2004; Young et al. 1995). In contrast to the general population, sex was not related to smoking, binge drinking and cannabis use (Swiss Statistics 2012). Age differences in smoking, alcohol and cannabis consumption observed in our SCI sample confirms findings from the general population (Swiss Statistics 2012). In contrast to the solid evidence on social inequalities in nutrition and smoking available for general populations (Gmel et al. 2013; Huisman et al. 2005; Lantz et al. 1998; Muff et al. 2010) or in cannabis use in SCI populations (Young et al. 1995), we could not observe a social gradient in our sample. Potentially, other factors such as secondary conditions (e.g., limitations in pulmonary or digestion functions) are more powerful predictors of nutrition or substance use in persons with SCI than is SEP. Also, social desirability in reporting nutrition habits or substance use among persons with lower income and lower education might explain our findings (Pryer et al. 1997). The literature on the association between social support and nutrition or substance use in general populations is inconsistent (Weyers 2007). Similar to our findings, a study in persons with SCI did not find associations between social support and alcohol or cannabis consumption (Young et al. 1995). Reviews on self-efficacy and nutrition quality (AbuSabha and Achterberg 1997) or smoking abstinence (Gwaltney et al. 2009) indicated modest but reliable associations of increased self-efficacy with non-smoking and enhanced nutrition quality. Against this evidence, general self-efficacy was neither related to nutrition, nor to substance use in our SCI sample. The GSE scale used in our survey was designed as a general indicator of self-efficacy (Schwarzer and Jerusalem 1995). A more tailored measure on beliefs about the ability to perform certain health behaviors might be necessary for better prediction.

Consistent with previous findings (Ma et al. 2000; Muff et al. 2010), we found co-occurrence of smoking, alcohol and cannabis consumption. Different influences might explain the co-use of substances such as environmental (easy availability, social acceptance), attitudinal (low health consciousness) or biological factors. However, further research is needed to better understand mechanisms influencing on the observed co-use of substances.

Several limitations of this study need to be considered. Findings are based on cross-sectional data, which does not allow conclusions on causal associations. Moreover, the used data rely on self-report, bias due to social desirability cannot be fully excluded. Concerning the comparison with the Swiss general population, one has to keep in mind that the measurements of alcohol and cannabis consumption were not identical, the variation in prevalence may partly be explained by different assessments used in the two samples. Furthermore,

Table 3 Nutrition and substance use by sex, age, socioeconomic position, social support and general self-efficacy

		Nutrition score (0–6) Mean (SD)	Pack years Mean (SD)	Current smoking *n* (%)	Daily grams of alcohol Mean (SD)	Binge drinking at least monthly *n* (%)	Cannabis consumption *n* (%)
Sex	Male	2.89 (1.44)	11.10 (18.10)	90 (24.66)	7.25 (9.40)	112 (30.85)	24 (6.56)
	Female	3.44 (1.38)	8.68 (17.7)	35 (25.55)	3.77 (6.40)	27 (20.30)	11 (8.03)
	p	<0.001	0.179	0.088	<0.001	0.020	0.564
Age in years	<45	2.90 (1.35)	4.31 (7.98)	43 (30.94)	4.24 (5.51)	43 (31.16)	21 (15.11)
	45–65	3.09 (1.54)	12.31 (19.26)	67 (26.38)	6.46 (8.67)	71 (28.29)	14 (5.49)
	>65	3.13 (1.34)	14.34 (22.57)	15 (13.76)	8.66 (11.64)	25 (23.36)	0 (0.00)
	p	0.357	0.029	0.002	0.005	0.400	<0.001
Socioeconomic position							
	High	3.01 (1.50)	8.32 (15.69)	27 (31.40)	5.70 (5.90)	17 (19.54)	7 (8.05)
	Middle to high	3.11 (1.52)	8.20 (14.30)	26 (20.80)	6.45 (9.39)	36 (29.03)	6 (4.80)
	Low to middle	2.92 (1.48)	10.30 (17.54)	40 (25.32)	6.38 (8.95)	50 (32.05)	14 (8.81)
	Low	3.09 (1.38)	14.93 (25.49)	21 (27.63)	4.68 (8.08)	19 (26.03)	4 (5.26)
	p	0.686	0.348	0.579	0.033	0.206	0.524
Social support							
Partner and living with others	Yes	2.97 (1.49)	9.88 (17.23)	58 (20.79)	6.51 (8.67)	83 (30.07)	13 (4.61)
	No	3.15 (1.43)	10.57 (19.10)	62 (31.63)	5.51 (8.30)	49 (25.52)	21 (10.82)
	p	0.100	0.508	0.013	0.007	0.282	0.010
No. of supportive persons	Highest tertile	3.13 (1.39)	9.37 (19.70)	41 (28.08)	5.31 (6.25)	41 (28.67)	12 (8.28)
	Middle tertile	2.99 (1.53)	9.82 (17.12)	35 (23.65)	6.57 (9.80)	32 (21.62)	10 (6.71)
	Lowest tertile	2.96 (1.44)	11.58 (17.49)	40 (23.95)	6.81 (9.93)	51 (31.10)	11 (6.55)
	p	0.469	0.458	0.628	0.985	0.154	0.814
Satisfaction with social support	Highest tertile	2.97 (1.51)	11.23 (20.40)	40 (25.16)	5.75 (8.10)	46 (29.30)	8 (5.06)
	Middle tertile	3.14 (1.47)	9.38 (16.05)	31 (25.62)	5.47 (6.74)	32 (26.02)	7 (5.69)
	Lowest tertile	2.98 (1.33)	11.26 (18.71)	35 (26.52)	6.46 (9.97)	36 (28.13)	15 (11.36)
	p	0.422	0.991	0.996	0.470	0.830	0.087
General self-efficacy (GSE)							
GSE scale	Highest tertile	3.16 (1.52)	11.14 (21.62)	39 (27.66)	6.41 (8.23)	36 (26.28)	8 (5.71)
	Middle tertile	2.92 (1.45)	9.68 (14.43)	43 (27.92)	5.71 (7.00)	51 (33.33)	17 (10.97)
	Lowest tertile	2.99 (1.38)	11.39 (18.42)	41 (22.28)	6.83 (10.62)	47 (25.68)	10 (5.38)
	p	0.275	0.707	0.257	0.388	0.246	0.099

p values from Kruskal-Wallis test for continuous outcomes, from chi-square test for categorical outcomes

Table 4 Confounding adjusted associations of sex, age, socioeconomic position, social support and general self-efficacy with nutrition and substance use

	Nutrition score OR (95 % CI)[a] *N*=504	Smoking status OR (95 % CI)[a] *N*=502	Pack years RR (95 % CI)[b] *N*=454	Daily grams of alcohol RR (95 % CI)[b] *N*=497	Binge drinking occasions OR (95 % CI)[a] *N*=496	Cannabis consumption OR (95 % CI)[c] *N*=503
Female	1.00	1.00	1.00	1.00	1.00	1.00
Male	0.46 (0.32–0.66)***	1.46 (0.95–2.26)	1.21 (0.91–1.59)	1.31 (0.96–1.77)**	1.68 (0.99–2.84)	1.00 (0.39–2.59)
Age in 10 years	1.14 (0.99–1.32)	0.80 (0.69–0.93)**	1.32 (1.21–1.45)***	1.19 (1.06–1.33)***	0.99 (0.83–1.18)	0.47 (0.84–0.62)***
Socioeconomic position						
High	1.00	1.00	1.00	1.00	1.00	1.00
Middle to high	1.20 (0.70–2.05)	0.78 (0.44–1.39)	1.06 (0.72–1.56)	1.16 (0.84–1.59)	2.04 (1.05–3.95)	0.37 (0.10–1.44)
Middle to low	0.97 (0.56–1.66)	0.76 (0.43–1.37)	1.23 (0.84–1.79)	1.09 (0.78–1.51)	2.40 (1.27–4.52)	0.71 (0.23–2.23)
Low	1.11 (0.61–2.01)	0.94 (0.47–1.88)	1.45 (0.94–2.24)	0.85 (0.55–1.31)	1.78 (0.82–3.91)	0.32 (0.06–1.77)
Social support						
No partner or living alone	1.23 (0.87–1.72)	1.23 (0.84–1.80)	1.24 (0.96–1.59)	0.98 (0.76–1.26)	0.74 (0.48–1.14)	1.90 (0.79–4.57)
No. of supportive persons	1.01 (1.00–1.03)	1.00 (0.96–1.04)	1.00 (0.99–1.02)	0.99 (0.89–1.01)	1.00 (0.98–1.03)	1.00 (0.96–1.04)
Satisfaction with social support	0.98 (0.95–1.01)	1.00 (0.98–1.02)	1.00 (0.98–1.02)	0.91 (0.79–1.04)	0.98 (0.93–1.02)	0.97 (0.92–1.03)
General self-efficacy scale	1.02 (1.00–1.05)	1.01 (0.98–1.05)	1.01 (0.99–1.04)	1.00 (0.98–1.03)	1.03 (0.99–1.07)	0.99 (0.93–1.06)

Abbreviations: *OR* odds ratio, *RR* rate ratio, *CI* confidence interval

[a] Effect sizes from ordinal logit regression

[b] Effect sizes from zero-inflated Poisson regression (RR for Poisson-part, *p* value for full model)

[c] Effect sizes from logistic regression

* $p<0.05$, ** $p<0.01$, *** $p<0.001$, *p* values from equal fraction-missing-information (FMI) test

Models were adjusted for all covariates, sociodemographic (migration background, language region, paid employment) and lesion characteristics (para/tetraplegia, completeness of lesion, aetiology and time since injury). Predictors and covariates imputed by multiple imputation, full case outcomes in this table. Results were weighted in order to match the target population of Swiss spinal cord injured persons

Table 5 Co-occurrence of poor nutritional status and substance use

	Smoking status		Pack years		Daily grams of alcohol		Binge drinking occasions		Cannabis consumption	
	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
Nutrition score (0–6)										
Kendall's tau	−0.03	−0.02	−0.03	−0.03	−0.12	−0.09	−0.07	−0.03	0.00	−0.01
95 % CI	−0.10–0.05	−0.08–0.04	−0.11–0.04	−0.09–0.04	−0.19–0.05	−0.15–0.03	−0.15–0.00	−0.09–0.03	−0.07–0.07	−0.07–0.05
p	0.448	0.445	0.408	0.412	<0.001	0.005	0.056	0.341	0.994	0.821
Smoking status										
Kendall's tau	–	–	0.73	0.44	0.12	0.10	0.15	0.09	0.28	0.14
95 % CI	–	–	0.69–0.78	0.41–0.48	0.05–0.19	0.05–0.16	0.08–0.24	0.03–0.15	0.21–0.35	0.08–0.20
p	–	–	<0.001	<0.001	0.001	<0.001	<0.001	0.002	<0.001	<0.001
Pack years										
Kendall's tau	–	–	–	–	0.15	0.12	0.17	0.10	0.16	−0.07
95 % CI	–	–	–	–	0.08–0.23	0.05–0.19	0.09–0.26	0.03–0.17	0.10–0.23	−0.14–0.00
p	–	–	–	–	<0.001	<0.001	<0.001	0.004	<0.001	0.038
Daily grams of alcohol										
Kendall's tau	–	–	–	–	–	–	0.34	0.16	0.09	0.06
95 % CI	–	–	–	–	–	–	0.28–0.41	0.10–0.22	0.01–0.17	0.00–0.12
P	–	–	–	–	–	–	<0.001	<0.001	0.021	0.043
Binge drinking occasions										
Kendall's tau	–	–	–	–	–	–	–	–	0.09	−0.01
95 % CI	–	–	–	–	–	–	–	–	−0.01–0.18	−0.08–0.06
p	–	–	–	–	–	–	–	–	0.09	0.801

Kendall's tau: rank correlation coefficient corrected for ties (tau-b)

Raw: rank correlation between raw scores

Adjusted: rank correlation between residuals of regression model adjusted for sociodemographic characteristics, social support and general self-efficacy

data on nutrition, alcohol and cannabis intake are to some extent crude. The construction of a sum score used to assess nutrition quality relies on restricted information on nutrition habits that must be interpreted with caution. Despite these limitations, our study has provided additional evidence on associated factors of nutrition and substance use in SCI by using a population-based community sample and by using data meeting high quality standards. Moreover, we used tailored statistical methods including corrections for item and unit nonresponse. Furthermore, by applying an elaborated weighting scheme, our study results may be representative for the entire Swiss SCI population.

In conclusion, results of this study in persons with SCI indicate age and sex differences in nutrition and substance use, observed co-occurrence of substance use and showed that meat and alcohol consumption was reduced and cannabis and liquid intake enhanced compared to the general population. SEP, social support and general self-efficacy were not related to nutrition and substance use in SCI, which raises the question whether other factors such as environmental barriers or health conditions relate to health behaviors in populations with severe disabilities. Our findings indicate that health promotion in persons with SCI should be age and sex sensitive. In order to reduce the risk of malnutrition, health interventions should be specifically targeted towards males. Non-smoking (tobacco and cannabis) interventions might be tailored for younger persons, while more attention should be paid to alcohol misuse prevention in older adults with SCI.

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