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Authors: Henchoz Y, Dupuis M, Deline S, Studer J, Baggio S, N'Goran AA, Daeppen JB, Gmel G

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Associations of physical activity and sport and exercise with at-risk substance use in young men: a longitudinal study

Yves HENCHOZ[a], Marc DUPUIS[a,b], Stéphane DELINE[a], Joseph STUDER[a], Stéphanie BAGGIO[a], Alexandra Adjua N'GORAN[a], Jean-Bernard DAEPPEN[a], Gerhard GMEL[a,c,d,e]

[a] Alcohol Treatment Centre, Lausanne University Hospital CHUV, Av. Beaumont 21 bis, Pavillon 2, CH - 1011 Lausanne, Switzerland

[b] Institute of Psychology, University of Lausanne, 'Geopolis' building, CH –1015 Lausanne

[c] Addiction Switzerland, Case postale 870, CH - 1001 Lausanne, Switzerland

[d] Centre for Addiction and Mental Health, 250 College St, Toronto, Ontario, M5T 1R8, Canada

[e] University of the West of England, Frenchay Campus, Coldharbour Lane, Bristol BS16 1QY, United Kingdom

Corresponding author and guarantor: Yves Henchoz; Alcohol Treatment Centre, Lausanne University Hospital CHUV, Av. Beaumont 21 bis, Pavillon 2, CH-1011 Lausanne, Switzerland; Yves.Henchoz@chuv.ch; Tel.:+41 21 314 01 39; Fax: +41 21 314 05 62

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HIGHLIGHTS

- Data from the Cohort Study on Substance Use Risk Factors (C-SURF) were used
- Physical activity, one of its components, sport, and substance use were analyzed.
- Physical activity is positively associated with at-risk alcohol use
- Sport is negatively associated with at-risk use of cigarettes and cannabis

ABSTRACT

Objective. This study aims to measure the associations of physical activity and one of its components, sport and exercise, with at-risk substance use in a population of young men.

Method. Baseline (2010–2012) and follow-up (2012–2013) data of 4748 young Swiss men from the Cohort Study on Substance Use Risk Factors (C-SURF) were used. Cross-sectional and prospective associations between at-risk substance use and both sport and exercise and physical activity were measured using Chi-squared tests and logistic regression models adjusting for covariates.

Results. At baseline, logistic regression indicated that sport and exercise is negatively associated with at-risk use of cigarettes and cannabis. A positive association was obtained between physical activity and at-risk alcohol use. At baseline, sport and exercise was negatively associated with at-risk use of cigarettes and cannabis at follow-up. Adjusted for sport and exercise, physical activity was positively associated with at-risk use of cigarettes and cannabis.

Conclusion. Sport and exercise is cross-sectionally and longitudinally associated with a low prevalence of at-risk use of cigarettes and cannabis. This protective effect was not observed for physical activity broadly defined. Taking a substance use prevention perspective, the promotion of sport and exercise among young adults should be encouraged.

Keywords: At-risk substance use, physical activity, prevention, sports, young adult

INTRODUCTION

In developed countries, heavy substance use is estimated to cause one third of deaths in young people (Toumbourou et al., 2007). Alcohol and illicit drug use are respectively the first and fifth risk factors for incident disability-adjusted life-years in 10–24-year-olds (Gore et al., 2011). In addition to the disease burden, research shows that most adolescent risk-taking behaviors, including substance use, track into adulthood and lead to health inequalities (Due et al., 2011). Understanding risk and protective factors for substance use is therefore an area of utmost importance for public health in young adults.

Numerous cross-sectional studies have been undertaken on the link between sport and substance use in young people. Regular sporting activity was found to be negatively associated with cigarette smoking (Mattila et al., 2012, Terry-McElrath and O'Malley, 2011, Lisha and Sussman, 2010) and cannabis use (Terry-McElrath and O'Malley, 2011, Lisha and Sussman, 2010), but positively associated with alcohol use (Terry-McElrath and O'Malley, 2011, Lisha and Sussman, 2010). Other authors reported less conclusive relationships (Verkooijen et al., 2008). The theme of sporting activity and substance use has only been addressed by a few recent longitudinal studies. Adolescence sporting activity was associated with an increasing use of alcohol over time (Mays et al., 2010, Wichstrom and Wichstrom, 2009, Peck et al., 2008, Eitle et al., 2003), but was found to be negatively associated with future cigarette smoking and cannabis use (Terry-McElrath and O'Malley, 2011, Wichstrom and Wichstrom, 2009, Audrain-McGovern et al., 2012).

An important deficiency in this area of research is that the aforementioned studies focused on sport and exercise, but did not cover other components of physical activity, including everyday physical activities during work, leisure time, housework and travel. Physical activity and sport and exercise are often used interchangeably but they are not equivalent, as Khan et al. (2012) recently underlined. They are also not mutually exclusive. Actually, sport and exercise is one component of physical activity. An individual may reach a given level of physical activity by playing tennis twice per week, and another individual may walk 30 min each day to get to work, but otherwise play no sport or do no exercise. There is strong evidence that the health benefits of physical activity (e.g. prevention of cardiovascular disease) are not restricted to vigorous exercise, but result also from moderately intense physical activities (Paffenbarger et al., 1986, Leon et al., 1987, Lee et al., 2000, Lee et al., 2001, Manson et al., 2002, Haskell et al., 2007). The importance of regular physical activity has also been emphasized in young people (Mountjoy, 2011). Although a few notable studies conducted on adolescent students' at-risk substance use took into account physical activity not related to sport and exercise, and suggested a protective effect of physical activity (e.g. Nelson and Gordon-Larsen, 2006,

Kulig et al., 2003), their conclusions cannot be generalized to young adults, for whom the relationship between physical activity and at-risk substance use has only been addressed by focusing on sport and exercise, but never by also considering the other components of physical activity.

The present study, therefore, aims to measure the cross-sectional and prospective associations between at-risk substance use and both physical activity and sport and exercise in a population of young men.

METHODS

Study design

Data from the Cohort Study on Substance Use Risk Factors (C-SURF) were analyzed. Participants were enrolled from 3 of 6 national army recruitment centers, covering 21 of 26 Swiss cantons (including all French-speaking ones). This provided a representative sample of young Swiss men, because army recruitment is obligatory in Switzerland and no pre-selection of recruits exists. However, baseline and follow-up assessments were done outside the army environment using questionnaires sent to home addresses. Baseline data were collected between September 2010 and March 2012, and follow-up data 15 months later, between January 2012 and April 2013.

Participants

At baseline, a total of 5990 participants completed the questionnaire. Among them, 5223 (87.2%) completed the follow-up questionnaire. Furthermore, a total of 475 participants were excluded for missing data (N=156) or outlying physical activity values (N=319). The analyses were based on a final sample consisting of 4748 participants (90.9% of follow-up responders). Excluded respondents had comparable baseline levels of physical activity (linear by linear association Chi-squared test, p=.266) and sport and exercise (p=.351) to participants included in the analyses. As recently reported by Studer et al. (2013), based on a short substance use questionnaire that was completed directly during recruitment regardless of any subsequent participation in the larger cohort study, the effects of non-response could be analyzed. Generally, effects were small. Lausanne University Medical School's Clinical Research Ethics Committee approved this study (Protocol No. 15/07).

Measures

Physical activity, sport and exercise, at-risk substance use and covariates were assessed at baseline. At follow-up, only at-risk substance use was assessed.

Physical activity. The level of physical activity was estimated using the short form of the International Physical Activity Questionnaire (IPAQ) (Gauthier et al., 2009). This covers activities performed at work, at home, when on the move and during leisure time (including sport and exercise). A multicenter study indicated adequate psychometric properties, at least as good as other established self-reports (Craig et al., 2003). The guidelines for data processing and analysis of the IPAQ (IPAQ Research Committee) were strictly followed. Briefly, algorithms that take into account the frequency, volume and intensity of the reported physical activities classify participants' level of physical activity as 'high', 'moderate' or 'low'.

Sport and exercise. A single question was used to measure sport and exercise: "Over the past 12 months, how often did you play sports or exercise?" Response choices were 1=never, 2=a few times a year, 3=1 to 3 times per month, 4=at least once per week or 5=almost every day. Sport and exercise was computed as 'never/rare' (1 or 2), 'occasional' (3) or 'regular' (4 or 5).

At-risk alcohol use. Both risky single occasion drinking (RSOD) and drinking volumes were considered. RSOD was defined as consuming at least 6 standard drinks on a single occasion (World Health Organization, 2000, McLeod et al., 1999). Pictures of standard drinks containing 10-12 g of pure alcohol were provided. At-risk RSOD was defined as RSOD at least monthly. Drinking volumes were assessed with the usual number of drinking days in a week and an open-ended question about the number of standard drinks consumed on those days. At-risk drinking volume was defined as 21 or more drinks per week (Marmot et al., 1995). Finally, at-risk alcohol use was defined as at-risk RSOD and/or at-risk drinking volume.

At-risk cigarette use. Participants were asked whether they had smoked cigarettes over the past 12 months. Frequency of cigarette use was recorded as 'once per month or less', '2–3 days per month', '1–2 days per week', '3–4 days per week', '5–6 days per week' and 'every day'. At-risk cigarette use was defined as a frequency of 5 days per week or more.

At-risk cannabis use. Similarly, participants were asked whether they had used cannabis over the past 12 months. Frequency of cannabis use was recorded as 'once per month or less', '2–4 times per month', '2–3 times per week', '4–5 times per week' and 'every day or almost every day'. At-risk cannabis use was defined as 2 times per week or more.

It is important to mention that the cut-offs used to define at-risk use of alcohol, cigarettes and cannabis do not imply that lower frequencies of use are safe. Nonetheless, they provide a valuable way of identifying individuals more at-risk of developing substance-related problems (EMCDDA, 2008).

Covariates. Covariates were measured and recorded as follows: *age*, *body mass index (BMI)* ('Underweight' [BMI < 18.5 kg/m^2]; 'Normal' [18.5 ≤ BMI < 25.0 kg/m^2]; 'Overweight' [25.0 ≤ BMI < 30.0 kg/m^2] ; 'Obesity' [BMI ≥ 30.0 kg/m^2]), *language* ('German'; 'French'), *financial situation* ('below average'; 'average or above'), *highest educational level achieved* ('lower secondary school'; 'vocational upper secondary school'; 'general upper secondary school' [high school or equivalent]; 'tertiary' [university or other graduate school]), *parents' educational level* ('lower secondary school'; 'vocational upper secondary school'; 'general upper secondary school' [high school or equivalent]; 'tertiary' [university or other graduate school]), *employment status* ('employed'; 'student'; 'inactive' [unemployed, social, disability pension]), *type of community* ('rural' [below 10000 inhabitants]; 'urban' [10000 inhabitants or above]).

Statistical analysis

The analysis was conducted using SPSS 21 software. Descriptive statistics were used to present the prevalence of at-risk substance use according to physical activity and sport and exercise. Linear by linear association Chi-squared tests were computed to test for any effects of physical activity and sport and exercise on at-risk substance use. To assess cross-sectional associations at baseline, 3 multiple logistic regression models were constructed by incorporating at-risk substance use as the dependant variable, and physical activity (model 1), sport and exercise (model 2) and physical activity and sport and exercise (model 3) as the independent variables. These models were run separately for at-risk use of alcohol, cigarettes and cannabis. In order to correct for influent factors, covariates were added to the models. Because physical activity and sport and exercise are variables with 3 ordinal modalities, the linear by linear association was also tested (models 1 and 2 only). To assess whether physical activity and sport and exercise at baseline were associated with at-risk use of alcohol, cigarettes and cannabis at follow-up (prospective associations), multiple logistic regression models were computed using the same procedure, but adjusting for baseline at-risk use of alcohol, cigarettes and cannabis respectively. The linear by linear association was also tested.

RESULTS

Table 1 displays the demographic and anthropometric characteristics of the sample. Mean (standard deviation) age was 19.96 (1.21) years at baseline and 21.26 (1.23) years at follow-up. Figure 1 illustrates baseline prevalence of at-risk substance use according to physical activity for each level of sport and exercise.

Table 2 presents the findings of Figure 1 when additionally controlling for confounding, i.e. a multiple logistic regression analysis using baseline data only. In models 1 and 2, where physical activity and sport and exercise were analyzed separately, there was a positive association between physical activity and at-risk alcohol use, and a negative association between sport and exercise and at-risk use of cigarettes and cannabis. Linear by linear associations (not indicated in Table 2) confirmed the positive dose-response relationship between physical activity and at-risk alcohol use (β=.187, p<.001), and the negative dose-response relationships between sport and exercise and at-risk use of cigarettes (β=-.455, p<.001) and cannabis (β=-.404, p<.001). In model 3, where physical activity and sport and exercise were adjusted for each other, the associations between sport and exercise and at-risk use of alcohol, cigarettes and cannabis remained stable. In contrast, there was a significant odds ratio (OR) of at-risk cigarette use for moderate (OR=1.45) and high (OR=1.52) compared to low physical activity, and a significant OR of at-risk cannabis use for moderate compared to low physical activity (OR=1.69).

Logistic regression models using baseline levels of physical activity and sport and exercise as independent variables, and at-risk substance use at follow-up as dependant variables, are depicted in Table 3. In models 1 and 2, where physical activity and sport and exercise were analyzed separately, physical activity at baseline tended to be positively associated with at-risk use of alcohol, cigarettes and cannabis at follow-up, although not significantly. There was a negative association between sport and exercise at baseline and at-risk use of cigarettes and cannabis at follow-up. Linear by linear associations (not indicated in Table 3) indicated a positive dose-response relationship between physical activity at baseline and at-risk alcohol use at follow-up (β=.111, p=.041), and a negative dose-response relationship between sport and exercise at baseline and at-risk use of cigarettes (β=-.230, p=.002) and cannabis (β=-.235, p=.018) at follow-up. Mutual adjustment between physical activity and sport and exercise (model 3) intensified the associations obtained in models 1 and 2. This resulted in a positive association between physical activity at baseline and at-risk cannabis use at follow-up, and a negative association between sport and exercise at baseline and at-risk use of cigarettes and cannabis at follow-up.

DISCUSSION

The present study aimed to compare the prevalence of at-risk substance use between different levels of physical activity and sport and exercise in a population of young men, both cross-sectionally and prospectively. Sport and exercise was negatively associated with at-risk use of cigarettes and cannabis. In contrast, physical activity, which includes sport and exercise as well as everyday activities during work, leisure time, housework, personal care and travel, correlated positively with at-risk use of alcohol. Prospective data indicated a negative association between sport and exercise at baseline and at-risk use of cigarettes and cannabis later on. Taking a substance use prevention perspective, these results underline the value of sport and exercise. Nevertheless, they also indicate that physical activity as a whole is triggered by occupational and lifestyle factors that have a negative impact on young people's substance use behavior.

Adjusting for physical activity (model 3) did not substantially change cross-sectional (Table 2) and longitudinal (Table 3) associations between sport and exercise and at-risk substance use. In contrast, when the associations between physical activity and at-risk substance use were adjusted for sport and exercise (model 3), positive associations were observed between physical activity and at-risk use of cigarettes and cannabis. Since sport and exercise is one component of physical activity, the fully adjusted models attenuated the part of sport and exercise in the physical activity measure, and accentuated the association of the other components of physical activity with at-risk substance use. Therefore, the part of physical activity that is not related to sport and exercise (e.g. occupational physical activity) seem to be positively associated with at-risk use of cigarettes and cannabis.

Sport and exercise was not found to be negatively associated with at-risk alcohol use. This is in line with previous cross-sectional studies indicating a higher level of alcohol consumption among sports participants (Terry-McElrath and O'Malley, 2011, Lisha and Sussman, 2010). Several hypotheses have been suggested to explain this counter-intuitive association, as reviewed in detail by Lisha et al. (2010). Briefly, because of their inherent competitive nature, sportsmen may be encouraged to drink larger quantities than non-sportsmen through peer pressure. Moreover, sport plays an important role in players' identities, and thus those of their teammates and sports partners: they may adjust their alcohol consumption according to their perception of other players' social norms. Finally, playing sport can be very stressful. Individuals may use alcohol to cope with the stress and anxiety associated to sport and exercise. O'Brien et al. (2007) reported higher levels of hazardous drinking among elite-provincial sportspeople than club/social sportspeople. The present study assessed sport and exercise regardless of the level of competition, which might explain the non-significant association with at-risk alcohol use.

Since sport and exercise is a component of physical activity, the aforementioned hypotheses (i.e. competition, identification and coping) may also be behind the positive association found between physical activity and at-risk alcohol use. However, other reasons are likely to exist too. Data from the 2003 Health Survey for England indicated that both sporting and physical occupational activities were positively associated with heavy drinking (Poortinga, 2007). In the present study, manual workers may have a high level of physical occupational activity that explains their elevated risk for alcohol consumption. Although the main potential confounders were controlled for, more specific factors related to culture and the working environment may be moderators of the relationship between physical activity and at-risk alcohol use.

At-risk use of cigarettes and cannabis was negatively associated with sport and exercise, but not with physical activity. Divergent associations of occupational and sporting activities with cigarette use were reported in the data from the 2003 Health Survey for England (Poortinga, 2007). Manual workers have a higher prevalence of tobacco use than other workers (Baumann et al., 2007, Barbeau et al., 2004). A US study conducted on the data of 2626 smokers described how blue-collar workers reported less pressure to quit, less social support for quitting, and less non-acceptability of smoking among their co-workers, than did other types of workers (Sorensen et al., 2002).

This study's main strength was that a validated questionnaire was used to measure physical activity in addition to sport and exercise. Previous studies had focused only on sport and exercise, which were often referred to as physical activity, despite the fact that a full spectrum activity was not covered. Other advantages of the study included a longitudinal design, a large nationally representative sample and adjustment for a comprehensive set of confounders. This study also had limitations. First, only men were included. Since gender seems to moderate the relationship between sport and exercise and substance use (Lisha and Sussman, 2010), the present findings must be interpreted with caution for young women. Second, the sample was representative of young Swiss men, but did not include young foreigners living in Switzerland, whose socio-demographic characteristics may relate differently to physical activity, sport and exercise and substance use. Third, sport and exercise was assessed using a single-item question, whose validity and reliability has not been tested. Finally, the short version of the IPAQ did not enable any differentiation between the different components of physical activity. The long version would be required for that purpose, although the feasibility of its use in the context of a cohort study may be a concern.

Conclusion

A positive association between physical activity and at-risk alcohol use was observed, but no relationship with at-risk use of cigarettes and cannabis. When adjusted for sport and exercise, the

associations between physical activity and at-risk use of cigarettes and cannabis became positive. Whereas sport and exercise is negatively associated with at-risk use of cigarettes and cannabis, it appears that one or several other components of physical activity favor substance use. Further research is needed to understand the mechanisms involved.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

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TABLES

Table 1. Baseline characteristics of study participants (collected between September 2010 and March 2012 among young men in 21 of 26 Swiss cantons).

Characteristics	N	%
Age (mean 19.96, SD 1.21)		
< 20	2869	60.4
≥ 20	1879	39.6
Body mass index (BMI)		
Underweight	165	3.5
Normal weight	3627	76.4
Overweight	775	16.3
Obesity	181	3.8
Language		
German	2146	45.2
French	2602	54.8
Financial situation		
Below average	665	14.0
Average or above	4083	86.0
Highest educational level achieved		
Lower secondary school	2327	49.0
Vocational upper secondary school	1101	23.2
General upper secondary school	1232	25.9
Tertiary	88	1.9
Parents' educational level		
Lower secondary school	274	5.8
Vocational upper secondary school	1631	34.4
General upper secondary school	819	17.2
Tertiary	2024	42.6
Employment status		
Employed	2181	45.9
Student	2300	48.4
Inactive	267	5.6
Type of community		
Rural	2866	60.4
Urban	1882	39.6

Notes: N = number of participants; SD = standard deviation.

Table 2. At-risk substance use at baseline as predicted by physical activity and sport and exercise using multiple logistic regression (collected between September 2010 and March 2012 among young men in 21 of 26 Swiss cantons).

	Alcohol OR (95% CI)	**Cigarettes OR (95% CI)**	**Cannabis OR (95% CI)**
Model 1 [#]			
Physical activity			
Low	1.00	1.00	1.00
Moderate	1.34 (1.07-1.67)	1.19 (0.91-1.56)	1.46 (0.99-2.15)
High	1.53 (1.25-1.88)	1.07 (0.84-1.36)	1.00 (0.69-1.45)
Model 2 [#]			
Sport and exercise			
Never/rare	1.00	1.00	1.00
Occasional	1.20 (0.96-1.50)	0.74 (0.59-0.94)	0.92 (0.66-1.27)
Regular	1.14 (0.96-1.36)	0.42 (0.34-0.5)	0.47 (0.36-0.61)
Model 3 [#]			
Physical activity			
Low	1.00	1.00	1.00
Moderate	1.34 (1.07-1.68)	1.45 (1.10-1.90)	1.69 (1.14-2.52)
High	1.54 (1.25-1.91)	1.52 (1.17-1.96)	1.34 (0.91-1.96)
Sport and exercise			
Never/rare	1.00	1.00	1.00
Occasional	1.16 (0.93-1.45)	0.72 (0.56-0.91)	0.89 (0.64-1.24)
Regular	1.03 (0.86-1.24)	0.38 (0.31-0.46)	0.46 (0.35-0.61)

Notes: OR = odds ratios; CI = confidence intervals; [#] = corrected for covariates.

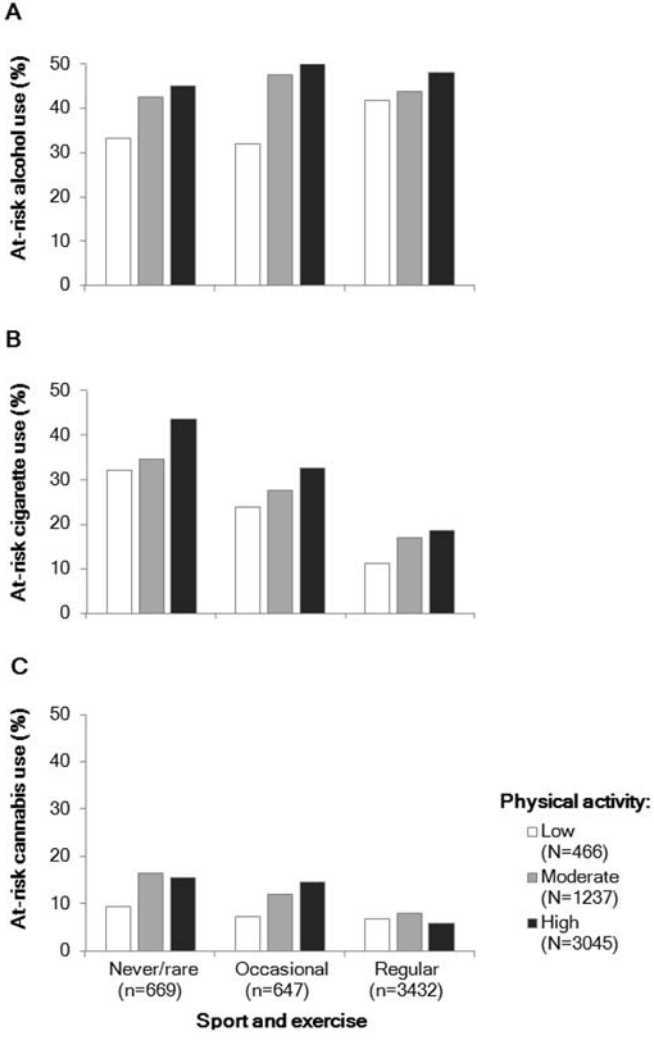
Table 3. At-risk substance use at follow-up as predicted by physical activity and sport and exercise at baseline using multiple logistic regression (collected between September 2010 and April 2013 among young men in 21 of 26 Swiss cantons).

	Alcohol OR (95% CI)	**Cigarettes OR (95% CI)**	**Cannabis OR (95% CI)**
Model 1 [#]			
Physical activity			
Low	1.00	1.00	1.00
Moderate	1.15 (0.88-1.50)	1.13 (0.76-1.69)	1.48 (0.82-2.66)
High	1.27 (0.99-1.62)	0.86 (0.60-1.25)	1.51 (0.87-2.61)
Model 2 [#]			
Sport and exercise			
Never/rare	1.00	1.00	1.00
Occasional	0.96 (0.74-1.26)	0.77 (0.53-1.13)	0.63 (0.38-1.04)
Regular	1.17 (0.95-1.44)	0.63 (0.46-0.85)	0.60 (0.40-0.89)
Model 3 [#]			
Physical activity			
Low	1.00	1.00	1.00
Moderate	1.12 (0.86-1.47)	1.23 (0.82-1.85)	1.63 (0.90-2.94)
High	1.20 (0.93-1.55)	1.00 (0.68-1.47)	1.78 (1.01-3.12)
Sport and exercise			
Never/rare	1.00	1.00	1.00
Occasional	0.95 (0.73-1.24)	0.77 (0.52-1.13)	0.60 (0.36-0.99)
Regular	1.12 (0.90-1.39)	0.64 (0.47-0.88)	0.54 (0.36-0.82)

Notes: OR = odds ratios; CI = confidence intervals; [#] = corrected for covariates.

FIGURE LEGEND

Figure 1. Baseline prevalence of at-risk use of alcohol (A), cigarettes (B) and cannabis (C) according to physical activity for different levels of sport and exercise among young Swiss men (collected between September 2010 and March 2012).


A
At-risk alcohol use (%)
50
40
30
20
10
0
B
At-risk cigarette use (%)
50
40
30
20
10
0
C
At-risk cannabis use (%)
50
40
30
20
10
0
Never/rare (n=669)
Occasional (n=647)
Regular (n=3432)
Sport and exercise
Physical activity:
Low (N=466)
Moderate (N=1237)
High (N=3045)