

## Adolescent elite athletes' cigarette smoking, use of snus, and alcohol

M. Martinsen<sup>1</sup>, J. Sundgot-Borgen<sup>2</sup>

<sup>1</sup>Oslo Sport Trauma Research Center, The Norwegian School of Sport Sciences, Oslo, Norway, <sup>2</sup>Department of Sports Medicine, The Norwegian School of Sport Sciences, Oslo, Norway

Corresponding author: Marianne Martinsen, Oslo Sport Trauma Research Center, The Norwegian School of Sport Sciences, Oslo 0806, Norway. Tel: +47 23 26 22 64, Fax: +47 22 23 42 20, E-mail: marianne.martinsen@nih.no

Accepted for publication 12 June 2012

The purpose was to examine cigarette smoking, use of snus, alcohol, and performance-enhancing illicit drugs among adolescent elite athletes and controls, and possible gender and sport group differences. First-year students at 16 Norwegian Elite Sport High Schools ( $n = 677$ ) and two randomly selected high schools (controls,  $n = 421$ ) were invited to participate. Totally, 602 athletes (89%) and 354 (84%) controls completed the questionnaire. More controls than athletes were smoking, using snus, and drinking alcohol. Competing in team sports was associated with use of snus [odds ratio = 2.8, 95% confidence interval (CI) 1.6 to 4.7] and a similar percentage of male and

female handball (22.2% vs 18.8%) and soccer players (15.7% vs 15.0%) reported using snus. For controls, not participating in organized sport was a predictor for smoking (odds ratio = 4.9, 95% CI 2.2 to 10.9). Female athletes were more prone to drink alcohol than males (46.3% vs 31.0%,  $P < 0.001$ ). Only, 1.2% athletes and 2.8% controls reported use of performance-enhancing illicit drugs. In conclusion, use of legal drugs is less common among athletes, but this relationship depends on type of sport and competition level. The association between team sports and use of snus suggests that sport subcultures play a role.

The use of snus is on the rise in Norway (Lund & Lindbak, 2007), Sweden (Lundqvist et al., 2009), Finland (Huhtala et al., 2006), and the US (Alpert et al., 2008). During the last few years, the largest increase has been among young people (Lund & Lindbak, 2007). Furthermore, it has been shown that young people who initiate tobacco use through using snus have many of the same predisposing factors as young smokers (Hagquist, 2007), which may indicate that the products recruit users from the same segment of the population (Lund et al., 2011). Finally, a recent Norwegian study found that adolescent's socioeducational status was associated with smoking for boys and girls, while there was no similar association with snus use (Overland et al., 2010).

Traditionally, it is believed that participation in sports lead to a healthier lifestyle and less use of recreational drugs (Pate et al., 1996; Baumert et al., 1998) and it has been reported that participation in sport may act as a protective factor against risky behavioral habits, such as alcohol, tobacco, or illicit drug use among adolescent athletes (McArdle et al., 2000; Pate et al., 2000; Bu et al., 2002). On the other hand, studies that have included older athletes suggest that sport participation may be associated with greater behavioral risk (Gay et al., 1990; Hildebrand et al., 2001), and that young athletes are more likely to use smokeless tobacco, have

an increased risk of alcohol use, and binge drink more than non-athletes (Rainey et al., 1996; Melnick et al., 2001). In addition, some studies have reported a higher prevalence of snus use among high school athletes compared with non-athletes (Hu et al., 1996; Melnick et al., 2001), while other studies have reported no difference (Buckhalt et al., 1992; Rainey et al., 1996; Baumert et al., 1998). The association between sports participation and the risk behaviors of drug use among adolescent athletes seems to depend on the kind of drug (Wechsler et al., 1997), type of sport (Challier et al., 2000) as well as gender (Kokotailo et al., 1996; Pate et al., 1996). Studies including adolescent elite athletes representing many different sports are deficient. Because use of snus, smoking, and drinking is associated with health risks, and alcohol and smoking might have negative effects on performance, it was important to examine the prevalence of athletes using these drugs. Furthermore, the recent years increase in use of snus has been largest among young people (Lund & Lindbak, 2007; Lund et al., 2011), and practical experience and some studies indicate that use of especially snus also is common among young athletes (Melnick et al., 2001; Haukka et al., 2006). Thus, there is a need for a study which includes a representative population of adolescent elite athletes representing a wide range of sports

Table 1. Classification of the 50 different sports into individual/team sports

Individual sports ( <i>n</i> = 242)				Team sports ( <i>n</i> = 360)
Dancing	Hepathlon	Snowboard	Nordic combined	Basketball
High jump	Decathlon	Chess	Cross country skiing	Soccer
Middle- and long distance running	Long jump	Table tennis	Cycling	Handball
Karate	Triple jump	Freestyle	BMX-cycling	Floorball
Tae kwon do	Judo	Motocross	Mountain-biking	Ice hockey
Fencing	Golf	Snow cross	Biathlon	Volleyball
Hammer	Shooting	Surfing	Orienteering	Beach volleyball
Hurdle	Gymnastics	Dog racing	Sprint	
Javelin	Tennis	Paddling	Discus	
Ski jump	Sailing	Rowing/sculling	Horse riding	
Swimming		Alpine skiing		

and in which athletes and controls fill out the same questionnaires.

Therefore, the purpose of this study was to examine the prevalence of cigarette smoking, alcohol use, snus use (low-nitrosamine smokeless tobacco, Swedish type), and use of performance-enhancing illicit drug among elite adolescent athletes representing 50 different sports and age-matched controls. Our research questions were as follows:

1. To what extent do adolescent elite athletes smoke, use snus, drink alcohol, and/or use performance-enhancing illicit drugs?
2. Is sport type and gender associated with the use of snus, alcohol, cigarettes, and performance-enhancing illicit drugs?

We hypothesized that cigarette smoking, use of snus, alcohol, and performance-enhancing illicit drugs were less common among both male and female athletes compared with controls. Furthermore, we hypothesized that cigarette smoking, use of snus, alcohol, and performance-enhancing illicit drugs were associated with type of sport and gender.

## Materials and methods

### Study design and participants

The participants in this study consisted of the total population of adolescent elite athletes (677 athletes) attending the Elite Sport High Schools in Norway (*n* = 16) and age-matched controls in two regular high schools (*n* = 421). An inclusion criterion was enrollment as a first-year student at one of the Norwegian Elite Sport High Schools (athletes) or at one of the two randomly selected high schools in Buskerud County in Norway (controls) and a birth date in 1992. Norwegian Elite Sport High Schools are selective, private and public high schools designed for highly talented athletes. The schools provide the best conditions possible, combining education and sports, and give athletes the opportunities to compete on a national or an international level and at the same time acquire high school graduation. Following initial screening, 711 athletes and 500 controls during the autumn of 2008 were invited to participate. A total of 29 athletes and 77 controls were excluded from the study (exclusion due to age: *n* = 29 athletes and

60 controls, no informed consent: *n* = 5 athletes and 19 controls). Of the 677 athletes and 421 controls eligible for the study, 66 athletes and 66 controls did not participate, and 14 athletes and two controls did not complete the questionnaire satisfactorily. A total of 602 athletes and 354 controls completed the study, giving a response rate of 89% for the athletes and 84% for the controls. The athletes represented 50 different sports. For part of the analysis, the sports were classified into individual sports and team sports as seen in Table 1. The study was approved by the Regional Committee for Medical and Health Science Research Ethics in Southern Norway and by the Norwegian Social Science Data Services. The respondents gave written consent to participate. Permission from parents to participate was required, and consent to collect data was obtained from the head of each school.

### Data collection

#### Questionnaire

A questionnaire including questions regarding health, use of tobacco, alcohol, and performance-enhancing illicit drugs, training and physical activity history, and eating behavior was administered to the respondents. Smoking and use of snus were measured by questions that separated never, occasional, and daily users. The questions were: "Are you smoking cigarettes now?" and "Are you using snus now?" With the categories: (1) yes, every day; (2) yes, occasionally; and (3) no. To measure the use of alcohol, the question was: "Do you drink alcohol?" with the following categories: (1) yes and (2) no. If the respondents answered yes, they were asked how often they used to drink/were drinking alcohol with the following categories: (1) less than once a month; (2) one to three times a month; (3) once a week; and (4) several times a week. Performance-enhancing illicit drug use was measured by the question: "Do you use or have you ever used any performance enhancing illicit drugs?" with the categories: yes and no. The athletes and the controls completed the questionnaire at school during school hour in the presence of one of the research group members. The participants were informed that an ID number was written on the questionnaire to make sure the analysis of the data was an anonymous process.

### Statistical analysis

The statistical analyses were carried out using PASW Statistics 18 for Windows (IBM Corporation, Route, Somers, NY, USA). Results are expressed as mean values  $\pm$  standard deviation for continuous data and absolute numbers (*n*) and percentages (%) for

Table 2. Prevalence of tobacco use among athletes and controls

	Occasional snus (%)			Daily snus (%)			Snus, total (%)		
	Athletes	Controls	P	Athletes	Controls	P	Athletes	Controls	P
Females	20 (9.2)	24 (15.4)	0.066	6 (2.8)	14 (9.0)	0.008	26 (11.9)	38 (24.4)	0.002
Males	45 (11.7)	30 (15.2)	0.242	29 (7.6) <sup>a</sup>	42 (21.2) <sup>b</sup>	<0.001	74 (19.3) <sup>c</sup>	72 (36.4) <sup>d</sup>	<0.001
Total	65 (10.8)	54 (15.3)	0.044	35 (5.8)	56 (15.8)	<0.001	100 (16.6)	110 (31.1)	<0.001

  

	Occasional smoke (%)			Daily smoke (%)			Smoke, total (%)		
	Athletes	Controls	P	Athletes	Controls	P	Athletes	Controls	P
Females	3 (1.4)	18 (11.5)	<0.001	–	7 (4.5)	*	3 (1.4)	25 (16.0)	<0.001
Males	2 (0.5)	25 (12.6)	<0.001	–	11 (5.6)	*	2 (0.5)	36 (18.2)	<0.001
Total	5 (0.8)	43 (12.1)	<0.001	–	18 (5.1)	<0.001	5 (0.8)	61 (17.2)	<0.001

Values are given in numbers and (percentage).

\*Because of small numbers, no statistical analysis was performed.

<sup>a</sup>P = 0.016 compared with female athletes;

<sup>b</sup>P = 0.002 compared with female controls;

<sup>c</sup>P = 0.020 compared with female athletes;

<sup>d</sup>P = 0.015 compared with female controls.

categorical data. The independent sample *t*-test was used to evaluate mean differences, and chi-square tests examined categorical frequencies. For chi-square tests in which one of the variables had more than two categories, linear-by-linear associations were used. For the athletes, two different binary logistic regression analyses were carried out for predicting the likelihood between use of snus and alcohol as the dependent variable and gender, sports group (team/individual), and smoking, snus/alcohol as fixed factors. Only 0.8% of the athletes reported smoking, and thus, a third binary logistic regression analysis with smoking as the dependent variable was only carried out for the controls. For controls, instead of sports group, they were asked whether they were involved with organized sports (yes/no). Because only 1.2% and 2.8% for athletes and controls reported use of performance-enhancing illicit drugs; no statistical analyses including this variable were performed. Odds ratios (ORs) are given with 95% confidence intervals (CIs). The significance level was set to 0.05.

## Results

### Participant characteristics

All participants were born in 1992, but the athletes were slightly younger than the controls at the data collection time ( $16.5 \pm 0.3$  vs  $16.9 \pm 0.3$ ,  $P < 0.001$ ). Among the controls, 54% met the Norwegian health recommendation for physical activity (1 h per day of moderate activity) (Sosial- og helsedirektoratet, 2000). Athletes reported training  $14.2 \pm 4.5$  h/week. A total of 22.3% of the athletes had competed at the international level.

### Smoking and use of snus

Table 2 shows that cigarette smoking (daily or occasional) was less common among athletes than controls (0.8% vs 17.2%,  $P < 0.001$ ). There was no difference in prevalence of smoking between males and females. However, a higher percentage of controls not involved in

organized sport compared with those participating in organized sports reported smoking (23.7% vs 7.1%,  $P < 0.001$ ). Furthermore, not participating in organized sport (OR = 4.9, 95% CI 2.2 to 10.9,  $P < 0.001$ ), use of snus (OR = 6.3, 95% CI 3.2 to 12.6,  $P < 0.001$ ) and alcohol (OR = 13.5, 95% CI 3.1 to 58.6,  $P = 0.001$ ) proved to be significant predictors for smoking among controls.

In addition, a higher percentage of controls compared with athletes reported use of snus (31.1% vs 16.6%,  $P < 0.001$ ), as well as a higher percentage of male athletes than female athletes (19.3% vs 11.9%,  $P = 0.020$ ) and control males than control females (36.4% vs 24.4%,  $P = 0.015$ ) (Table 2). Forty-one percent of the controls reporting use of snus were occasional or daily smokers. In addition, five athletes reported smoking and four of these also reported using snus.

### Use of alcohol

A higher percentage of controls compared with athletes (63.0% vs 36.5%,  $P < 0.001$ ) and female compared with male athletes (46.3% vs 31.0%,  $P < 0.001$ ) reported drinking alcohol. Furthermore, a higher percentage of the controls who reported drinking alcohol reported drinking one to three times a month compared with athletes (Table 3). Only males (athlete and control) reported drinking several times a week.

### Use of performance-enhancing illicit drugs

A total of seven athletes, 1.2% (one female and six males), and 10 controls, 2.8% (three females and seven males), reported use of performance-enhancing illicit

Table 3. Athletes and controls who reported use of alcohol

Variable	Females			Males		
	Athletes	Controls	<i>P</i>	Athletes	Controls	<i>P</i>
	<i>n</i> = 94	<i>n</i> = 103		<i>n</i> = 117	<i>n</i> = 120	
Less than once a month	67 (71.3)	33 (32.0)	<0.001	79 (67.5)	26 (21.7)	<0.001
1–3 times a month	24 (25.5)	65 (63.1)	<0.001	35 (29.9)	76 (63.3)	<0.001
Once a week	3 (3.2)	5 (4.9)	*	2 (1.7)	15 (12.5)	*
Several times a week	–	–	*	1 (0.9)	3 (2.5)	*

Values are given in numbers and (percentage).

Data regarding frequency was not available for nine athletes.

\*Because of small numbers, no statistical analysis was performed.

Table 4. Prevalence of alcohol and snus use among athletes competing in individual and team sports

Variable	Females			Males			Total		
	Individual	Team	<i>P</i>	Individual	Team	<i>P</i>	Individual	Team	<i>P</i>
	<i>n</i> = 104	<i>n</i> = 114		<i>n</i> = 137	<i>n</i> = 247		<i>n</i> = 241	<i>n</i> = 361	
Current snus use									
Daily/occasional	7 (6.7)	19 (16.7)	0.024	16 (11.7)	58 (23.5)	0.005	23 (9.5)	77 (21.3)	<0.001
Use of alcohol									
Yes	47 (45.2) <sup>a</sup>	54 (47.4) <sup>b</sup>	0.75	41 (30.0)	78 (31.6)	0.74	88 (36.5)	132 (36.6)	0.99

Values are given in numbers (percentage).

<sup>a</sup>*P* = 0.015 compared with male athletes competing in individual sports;

<sup>b</sup>*P* = 0.004 compared with male athletes competing in team sports.

Table 5. Logistic regression analysis with use of snus and use of alcohol as the dependent variables in athletes and controls

	Use of snus			Use of alcohol		
	B	Odds ratio (95% CI)	<i>P</i>	B	Odds ratio (95% CI)	<i>P</i>
Athletes						
Gender	0.865	2.4 (1.4 to 4.0)	0.001	−0.825	0.44 (0.3 to 0.6)	<0.001
Team sport	1.016	2.8 (1.6 to 4.7)	<0.001	−0.105	0.90 (0.6 to 1.3)	0.57
Use of alcohol/snus	1.643	5.2 (3.2 to 8.4)	<0.001	1.633	5.1 (3.2 to 8.3)	<0.001
Smoking	3.101	22.2 (2.3 to 211)	0.007	0.836	2.3 (0.2 to 22.6)	0.47
Controls						
Gender	0.771	2.2 (1.2 to 3.7)	0.006	−0.498	0.61 (0.4 to 1.0)	0.048
Not organized sport	−0.035	0.97 (0.6 to 1.7)	0.90	−0.163	0.85 (0.5 to 1.4)	0.52
Use of alcohol/snus	1.714	5.5 (2.8 to 11.0)	<0.001	1.703	5.5 (2.8 to 10.9)	<0.001
Smoking	1.838	6.3 (3.1 to 12.5)	<0.001	2.551	12.8 (3.0 to 55.5)	0.001

CI, confidence interval.

drugs. None of the athletes reported which performance-enhancing illicit drugs they used.

#### Snus and alcohol use among athletes in different sport groups

Use of snus was more common among athletes competing in team sports than in individual sports (21.3% vs 9.5%, *P* < 0.001) (Table 4). There was no difference between the sport groups and use of alcohol (team 36.6%

vs 36.5%, *P* = 0.99), but a higher prevalence of female athletes in both individual and team sports vs male athletes in the same sport groups reported use of alcohol (Table 4). With logistic regression analysis, team sports proved to be a significant predictor for use of snus and gender for drinking alcohol among athletes (Table 5). Also, smoking was strongly associated with snus, but due to few smokers among the athletes, the CI was very high. Still, use of snus was at least 2.3 times as high among smokers as non-smokers. In addition, use of snus

Table 6. Prevalence of snus use among the different team sports

	Daily			Occasional			Total (daily or occasional)		
	Females	Males	Total	Females	Males	Total	Females	Males	Total
Ice hockey, <i>n</i> = 47	–	8 (17.0)	8 (17.0)	–	12 (25.5)	12 (25.5)	–	20 (42.6) <sup>a</sup>	20 (42.6) <sup>a,b</sup>
Floorball, <i>n</i> = 12	–	–	–	1 (50.0)	5 (50.0)	6 (50.0)	1 (50.0)	5 (50.0)	6 (50.0)*
Handball, <i>n</i> = 100	2 (3.1)	3 (8.3)	6 (5.0)	10 (15.6)	5 (13.9)	15 (15.0)	12 (18.8)	8 (22.2)	20 (20.0)
Soccer, <i>n</i> = 180	4 (10.0)	10 (7.1)	14 (7.8)	2 (5.0)	12 (8.6)	14 (7.8)	6 (15.0)	22 (15.7)	28 (15.6)
Basketball, <i>n</i> = 16	–	3 (21.4)	3 (18.8)	–	–	–	–	3 (21.4)	3 (18.8)*

Values are given in numbers and (percentage).

\*Because of small numbers, no analyses were performed.

<sup>a</sup>*P* < 0.001 compared with soccer;

<sup>b</sup>*P* < 0.01 compared with handball.

was a strong predictor for alcohol use, and athletes who reported using snus were over five times more likely to report drinking alcohol than athletes not reporting using snus (Table 5).

Most of the athletes competing in team sports were involved in handball, soccer, or ice hockey (Table 6). Volleyball players were also included in this study, but none of the volleyball or beach volleyball players reported use of snus.

#### Snus and alcohol use among controls in organized sports

Among controls, we found no difference in snus use and alcohol drinking between those involved in organized sports compared with those not involved in such activities (snus: 28.1% vs 33.0%, *P* = 0.324; alcohol: 60.4% vs 64.7%, *P* = 0.422). However, gender proved to be a significant predictor of snus and alcohol use, where male controls were more likely to use snus and female controls more likely to use alcohol compared with each other (Table 5). In contrast to the athletes, smoking was a strong predictor for both snus and alcohol use among the controls.

#### Discussion

The main finding in this study was the higher prevalence of smoking, snus, and alcohol use among the controls compared with the elite adolescent athletes, and that female athletes were more prone to drink alcohol than male athletes. Furthermore, a higher frequency of athletes competing in team sports vs individual sports reported use of snus, and a similar percentage of male and female athletes in handball (22.2% vs 18.8%) and soccer (15.7% vs 15.0%) reported use of snus. Finally, for both athletes and controls, snus use proved to be a strong predictor for alcohol drinking.

In contrast to some studies (Hu et al., 1996; Davis et al., 1997; Tomar & Giovino, 1998; Melnick et al., 2001), snus use was less common among athletes than

controls (16.6% vs 31.1%, *P* < 0.001) in our study. The discrepancy from the results in the other studies might be explained by the fact that all the athletes included in this study are elite upcoming athletes attending Elite Sport High Schools in which snus use is forbidden or not accepted. Another explanation might be the possibility that some of the athletes are conscious about the health risks and the negative performance effects snus might have (Strømme, 1989). In accordance with other studies on adolescent athletes (Huhtala et al., 2006; Grotvedt et al., 2007), we found a higher prevalence of snus use among male athletes than female athletes and a wide variation in the patterns of snus use in different sports (Walsh et al., 1994; Green et al., 2001; Alaranta et al., 2006). Our finding that snus use was more common among team sport athletes than athletes in individual sports is in accordance with the results from Alaranta et al. (2006). They reported snus use to be more common in team sports compared with other sports and controls. In our study, the prevalence of snus use was almost three times higher for athletes competing in team sports than individual sports (OR = 2.8, 95% CI 1.6 to 4.7). Furthermore, and as expected, snus use was more common in ice hockey as compared with soccer and handball. We were surprised to find that 20.0% of all male and female handball players used snus and that the prevalence in handball was as high as in soccer (15.6%, *P* = 0.344). In Sweden, snus use is more common among adolescent ice hockey players than the general male population, and snus use is more common than smoking among male ice hockey players, and the use of snus is higher among ice hockey players than in any other sports (Rolandsson & Hugoson, 2000, 2001, 2003; Galanti et al., 2001). These findings suggest that the subculture of a particular sport might socialize athletes into use of drugs such as snus. It has also been reported that the ice hockey environment is more linked to snus use as compared with other sports (Rolandsson et al., 2006). Athletes in the Rolandsson et al. study (2006) also reported that athletes experienced snus use among older players and coaches at an early age. Due to the feeling of a consenting attitude from the



coaches regarding snus use compared with smoking, athletes thought that their coaches believed smoking would affect the physical condition more than using snus. Therefore, athletes think that coaches imply a consenting attitude to ward snus use (Rolandsson et al., 2006). From our questionnaire, we are not able to conclude that this also is the case in our study, but the fact that team sports was a significant predictor for snus use and not for alcohol use, the higher prevalence in sports such as ice hockey and soccer might indicate that collective thinking, peer pressure, and the environment in which the athletes practice their sport also have a significant impact on these young athletes.

In Norway, the minimum legal age for buying tobacco and alcohol is 18, and since 2004, it has been illegal to smoke in restaurants and bars. For the general population, this ban may have effected changes in the preference of tobacco type being preferred among tobacco users. Although the sale of tobacco for smoking has decreased and the sale of snus has increased, still more people are smoking than using snus in Norway (Lund & Lindbak, 2007). In contrast to the situation in Norway, the sale of snus is illegal in all European countries included in the European Union except for Sweden where snus use is believed to reduce the prevalence of smoking (Fagerstrom & Schildt, 2003; Rodu & Cole, 2004; Ramstrom & Foulds, 2006). Recent Norwegian data have also shown an association between use of snus and quit rates for smoking, and thus support the hypothesis that the availability to snus increases the quit-smoking ratio (Lund et al., 2011). However, in contrast to Sweden, almost half of Norwegian snus users use snus only occasionally (Lund & Lindbak, 2007), and in this group, the quit ratio for smoking is low (Lund et al., 2011). Furthermore, surveys including young snus users (16–20 years) indicate that almost half of them are primary users, and thus, the quit ratio for smoking may be very low in this age group (Lund et al., 2011). In our study, we had very few athletes that are combination users (smokers and snus users) and only five athletes reported smoking. Thus, most of the athletes who reported using tobacco were primary snus users. In contrast, one in five of the controls reported smoking daily or occasionally, and smoking proved to be a strong predictor for snus use. The finding that controls involved in organized sport were less likely to smoke compared with those not involved with organized sport is in accordance with previous studies reporting that fewer physically active adolescents are smoking compared with less physically active peers (Thorlindsson et al., 1990; Pate et al., 1996; Melnick et al., 2001). Thus, participating in sports seems to be associated with no smoking. It is well known that use of cigarettes at a regular basis reduces physical ability and it has been suggested that the low number of smoking athletes is due to the awareness of the detrimental effect on health and performance (Pederson et al., 1992;

Wechsler et al., 1997; Melnick et al., 2001). This might explain why only five athletes in our study reported smoking (occasionally). Similar to snus use, smoking by adult role models constitutes a powerful influence on the smoking behavior of adolescents (Melnick et al., 2001). Because coaches, athletic trainers, and older athletes are less likely to smoke, it has been speculated that athletes have more positive role models than non-athletes which may lower their risk of becoming smokers (Melnick et al., 2001).

An interesting finding was that gender proved to be a significant predictor for alcohol use among the athletes in this study. More females than males reported drinking alcohol (46% vs 31%,  $P < 0.001$ ). Research comparing the prevalence of alcohol use among athletes and non-athletes has shown conflicting results. Martens and colleagues' (2006) systematic review of college athletes' drinking behavior revealed inconsistent findings, some studies indicated that athletes consumed more alcohol than non-athletes and other indicated no differences or less consumption of alcohol. A recent review by (Lisha & Sussman, 2010) found that 22 of the 29 studies that examined the relationship between participation in sports and alcohol consumption reported a positive association. Our findings of lower prevalence of alcohol use among the athletes compared with the controls concur with a study by Peretti-Watel et al. (2003). But, it should be mentioned that in their study, data representing separate databases and a different age range were included and therefore, a comparison is not necessarily appropriate. Among our athletes, we found no differences in drinking frequency, and only one male athlete reported drinking several times a week. Unfortunately, our study was not designed to test the hypothesis that athletes have different drinking habits depending on being in or off season and the assumption that athletes binge drink more than non-athletes. The study by Green et al. (2001) investigating substance abuse habits in college student athletes indicated that there were higher rates of alcohol use and more binge drinking among college athletes than non-athletes.

We found no difference in the prevalence of performance-enhancing illicit drug use between athletes (1.2%) and controls (2.8%). Additionally, the low number of both athletes and controls reporting such use made further analysis between gender and different sport groups impossible. Our results might indicate that there is no culture for Norwegian adolescent elite athletes to use performance-enhancing illicit drugs. On the other hand, the athletes in our study might have underreported the use in fear of being detected and eventual consequences because many of the Elite Sport High Schools have strict rules on drug use. However, this is in agreement with the findings reported in Lisha & Sussman (2010). Nine of the 15 studies found a relationship between sport participation and low use of illicit drugs (using a broad definition). A positive relationship was

found in two studies (Green et al., 2001; Rockafellow & Saules, 2006), and three studies indicated that the relationship depended on gender and type of sport (Ewing, 1998; Peretti-Watel et al., 2002; Ford, 2007). Due to the conflicting results regarding the use of illicit drugs among athletes and the lack of studies including adolescent elite athletes, we suggest that the relationship between participation in competitive sport and use of illicit drugs should be further examined. More studies should include adolescent elite athletes and specific type of drug (both performance-enhancing and recreational) to determine the directionality of the possible relationships, and thus, better inform future drug prevention efforts in this domain.

This study was limited by the same conceptual and methodological concerns that apply to all cross-sectional studies; it is impossible to determine whether a cause-and-effect relationship exists. Furthermore, most of the Norwegian Elite Sport High Schools have regulations on use of drugs. This might have affected the results. Athletes may have underreported their use of drugs due to their fear of being “discovered.” Another limitation is that we did not ask the athletes if their use of drugs changed during the season. This may have affected the results. On the other hand, our inclusion of a large number of sports may have eliminated this limitation because both in and out of season athletes were included in this study.

## Perspectives

Competing in sport at a high level during adolescence seems to be associated with less smoking, drinking, and

snus use as compared with adolescent not participating in competitive sports. On the other hand, taken into consideration the fact that the athletes included in this study are upcoming elite athletes, the percentage of the athletes reporting drinking alcohol and snus use is worth noticing. Also, the finding that representing a team sport was a predictor for snus use indicates that young elite athletes competing in team sports such as handball, football, and ice hockey might be at increased risk of using snus. Due to the high response rate and large number of sports included, we believe that results from this study are generalizable to other elite adolescent athletes representing team and individual sports. Therefore, it is essential to continue and further develop sport-specific prevention programs against the use of recreational drugs and especially snus among both male and female athletes and non-athletes.

**Key words:** recreational drugs, drinking, performance, smokeless tobacco, non-athletes.

## Acknowledgements

We acknowledge the comments of Professor Glyn Roberts in the preparation of this manuscript. We also thank all the subjects and their coaches for cooperation and support during this study. The Oslo Sport Trauma Research Center has been established at the Norwegian School of Sport Sciences through generous grants from the Royal Norwegian Ministry of Culture, the South-Eastern Norway Regional Health Authority, the International Olympic Committee, the Norwegian Olympic Committee & Confederation of Sport, and Norsk Tipping AS. This project has been established through a grant from Olympiatoppen.

## References

- Alaranta A, Alaranta H, Patja K, Palmu P, Prattala R, Martelin T, Helenius I. Snuff use and smoking in Finnish Olympic athletes. *Int J Sports Med* 2006; 27: 581–586.
- Alpert HR, Koh H, Connolly GN. Free nicotine content and strategic marketing of moist snuff tobacco products in the United States: 2000–2006. *Tob Control* 2008; 17: 332–338.
- Baumert PW, Henderson JM, Thompson NJ. Health risk behaviors of adolescent participants in organized sports. *J Adolesc Health* 1998; 22: 460–465.
- Bu ETH, Watten RG, Foxcroft DR, Ingebrigtsen JE, Relling G. Teenage alcohol and intoxication debut: the impact of family socialization factors, living area and participation in organized sports. *Alcohol Alcohol* 2002; 37: 74–80.
- Buckhalt JA, Halpin G, Noel R, Meadows ME. Relationship of drug-use to involvement in school, home, and community activities results of a large survey of adolescents. *Psychol Rep* 1992; 70: 139–146.
- Challier B, Chau N, Predine R, Choquet M, Legras B. Associations of family environment and individual factors with tobacco, alcohol and illicit drug use in adolescents. *Eur J Epidemiol* 2000; 16: 33–42.
- Davis TC, Arnold C, Nandy I, Bocchini JA, Gottlieb A, George RB, Berkel H. Tobacco use among male high school athletes. *J Adolesc Health* 1997; 21: 97–101.
- Ewing BT. High school athletes and marijuana use. *J Drug Educ* 1998; 28: 147–157.
- Fagerstrom KO, Schildt EB. Should the European Union lift the ban on snus? Evidence from the Swedish experience. *Addiction* 2003; 98: 1191–1195.
- Ford JA. Substance use among college athletes: a comparison based on sport/team affiliation. *J Am Coll Health* 2007; 55: 367–373.
- Galanti MR, Rosendahl I, Post A, Gilljam H. Early gender differences in adolescent tobacco use – the experience of a Swedish cohort. *Scand J Public Health* 2001; 29: 314–317.
- Gay JE, Minelli MJ, Tripp D, Keilitz D. Alcohol and the athlete – a university response. *J Alc Drug Educ* 1990; 35: 81–86.
- Green GA, Uryasz FD, Petr TA, Bray CD. NCAA study of substance use and abuse habits of college student-athletes. *Clin J Sport Med* 2001; 11: 51–56.
- Grotvedt L, Hovengen R, Graff-Iversen S, Stigum H. Smoke- and smokeless tobacco use among Norwegian adolescents. *Eur J Public Health* 2007; 17: 81.
- Hagquist CEI. Health inequalities among adolescents – the impact of academic orientation and parents’ education. *Eur J Public Health* 2007; 17: 21–26.
- Haukkala A, Vartiainen E, De Vries H. Progression of oral snuff use among Finnish 13–16-year-old students and its relation to smoking behaviour. *Addiction* 2006; 101: 581–589.

- Hildebrand KM, Bogle KL, Johnson DJ. Comparison of patterns of alcohol use between high school and college athletes and nonathletes. *Res Q Exerc Sport* 2001; 72: A30.
- Hu FB, Hedeker D, Flay BR, Sussman S, Day LE, Siddiqui O. The patterns and predictors of smokeless tobacco onset among urban public school teenagers. *Am J Prev Med* 1996; 12: 22–28.
- Huhtala HSA, Rainio SU, Rimpela AH. Adolescent snus use in Finland in 1981–2003: trend, total sales ban and acquisition. *Tob Control* 2006; 15: 392–397.
- Kokotailo PK, Henry BC, Koscik RE, Fleming MF, Landry GL. Substance use and other health risk behaviors in collegiate athletes. *Clin J Sport Med* 1996; 6: 183–189.
- Lisha NE, Sussman S. Relationship of high school and college sports participation with alcohol, tobacco, and illicit drug use: a review. *Addict Behav* 2010; 35: 399–407.
- Lund KE, Scheffels J, McNeill A. The association between use of snus and quit rates for smoking: results from seven Norwegian cross-sectional studies. *Addiction* 2011; 106: 162–167.
- Lund M, Lindbak R. Norwegian Tobacco Statistics 1973–2006. 2007. Oslo, Statens institutt for rusmiddelforskning. 1-10-2011.
- Lundqvist G, Sandstrom H, Ohman A, Weinehall L. Patterns of tobacco use: a 10-year follow-up study of smoking and snus habits in a middle-aged Swedish population. *Scand J Public Health* 2009; 37: 161–167.
- Martens MP, Dams-O'Connor K, Beck NC. A systematic review of college student-athlete drinking: Prevalence rates, sport-related factors, and interventions. *J Subst Abuse Treat* 2006; 31: 305–316.
- McArdle P, Wiegersma A, Gilvarry E, McCarthy S, Fitzgerald M, Kolte B, Binkley A, Blom M, Stoeckel I, Pierolini A, Michels I, Johnson R, Quensel S. International variations in youth drug use: the effect of individual behaviours, peer and family influences, and geographical location. *Eur Addict Res* 2000; 6: 163–169.
- Melnick MJ, Miller KE, Sabo DF, Farrell MP, Barnes GM. Tobacco use among high school athletes and nonathletes: results of the 1997 Youth Risk Behavior Survey. *Adolescence* 2001; 36: 727–747.
- Overland S, Tjora T, Hetland J, Aaro LE. Associations between adolescent socioeducational status and use of snus and smoking. *Tob Control* 2010; 19: 291–296.
- Pate RR, Heath GW, Dowda M, Trost SG. Associations between physical activity and other health behaviors in a representative sample of US adolescents. *Am J Public Health* 1996; 86: 1577–1581.
- Pate RR, Trost SG, Levin S, Dowda M. Sports participation and health-related behaviors among US youth. *Arch Pediatr Adolesc Med* 2000; 154: 904–911.
- Pederson LL, Poulin M, Lefcoe NM, Donald AW, Hill JS. Does cigarette-smoking affect the fitness of young-adults rationale and protocol for future-research. *J Sports Med Phys Fitness* 1992; 32: 96–105.
- Peretti-Watel P, Beck F, Legleye S. Beyond the U-curve: the relationship between sport and alcohol, cigarette and cannabis use in adolescents. *Addiction* 2002; 97: 707–716.
- Peretti-Watel P, Guagliardo V, Verger P, Pruvost J, Mignon P, Obadia Y. Sporting activity and drug use: alcohol, cigarette and cannabis use among elite student athletes. *Addiction* 2003; 98: 1249–1256.
- Rainey CJ, McKeown RE, Sargent RG, Valois RF. Patterns of tobacco and alcohol use among sedentary, exercising, nonathletic, and athletic youth. *J Sch Health* 1996; 66: 27–32.
- Ramstrom LM, Foulds J. Role of snus in initiation and cessation of tobacco smoking in Sweden. *Tob Control* 2006; 15: 210–214.
- Rockafellow BD, Saules KK. Substance use by college students: the role of intrinsic versus extrinsic motivation for athletic involvement. *Psychol Addict Behav* 2006; 20: 279–287.
- Rodu B, Cole P. The burden of mortality from smoking: comparing Sweden with other countries in the European Union. *Eur J Epidemiol* 2004; 19: 129–131.
- Rolandsson M, Hallberg LRM, Hugoson A. Influence of the ice-hockey environment on taking up snuff: an interview study among young males. *Acta Odontol Scand* 2006; 64: 47–54.
- Rolandsson M, Hugoson A. Changes in tobacco habits – a prospective longitudinal study of tobacco habits among boys who play ice hockey. *Swed Dent J* 2003; 27: 175–184.
- Rolandsson M, Hugoson A. Factors associated with snuffing habits among ice-hockey-playing boys. *Swed Dent J* 2001; 25: 145–154.
- Rolandsson M, Hugoson A. Knowledge and habits of tobacco among ice-hockey-playing boys – an intervention study. *Swed Dent J* 2000; 24: 59–70.
- Sosial- og helsedirektoratet. Fysisk aktivitet og helse. Anbefalinger. 2. 2000. Oslo, Sosial- og helsedirektoratet.
- Strømme SB. Er snusrusen verdt 'prisen'? Om fysiologiske virkninger av snus. *Norsk Tidsskrift for idrettsmedisin* 1989; 4: 7.
- Thorlindsson T, Vilhjalmsson R, Valgeirsson G. Sport participation and perceived health-status – a study of adolescents. *Soc Sci Med* 1990; 31: 551–556.
- Tomar SL, Giovino GA. Incidence and predictors of smokeless tobacco use among US youth. *Am J Public Health* 1998; 88: 20–26.
- Walsh MM, Hilton JF, Ernster VL, Masouredis CM, Grady DG. Prevalence, patterns, and correlates of spit tobacco use in a college athlete population. *Addict Behav* 1994; 19: 411–427.
- Wechsler H, Davenport AE, Dowdall GW, Grossman SJ, Zanakos SI. Binge drinking, tobacco, and illicit drug use and involvement in college athletics – a survey of students at 140 American colleges. *J Am Coll Health* 1997; 45: 195–200.