

Does sports participation during adolescence prevent later alcohol, tobacco and cannabis use?

Tove Wichstrøm¹ & Lars Wichstrøm²

Lade Treatment Centre for Alcohol and Drug Abuse, Trondheim, Norway¹ and Department of Psychology, Norwegian University of Science and Technology, Trondheim, Norway²

ABSTRACT

Aims To study whether participation in organized sports during adolescence predicts increased smoking of tobacco, alcohol intoxication and cannabis use from late adolescence to adulthood when controlling for potential confounders. Moreover, to study whether such increased drug use varies according to type of sport (team versus individual), main skills needed (endurance, strength or technical) and level of competition. **Design, setting and participants** Survey of national sample of Norwegian high school students (aged 13–19 years) in 1992 (T1) followed-up in 1994 (T2), 1999 (T3) and 2006 (T4) ($n = 3251$). **Measurements** Outcome measures included smoking of tobacco and 12-month prevalences of alcohol intoxication and cannabis use, respectively. Confounders included pubertal timing, friends' drug use, perceived social acceptance, grades and parental socio-economic status. **Findings** Latent growth curve analyses showed that initial level of participation in organized sports predicted growth in alcohol intoxication. Those involved initially in team sports had greater growth in alcohol intoxication, but lower growth in tobacco use and cannabis use, during the adolescent and early adult years compared to those involved in technical or strength sports. Practising endurance sports, as opposed to technical or strength sports, predicted reduced growth in alcohol intoxication and tobacco use. **Conclusions** Sports participation in adolescence, and participation in team sports in particular, may increase the growth in alcohol intoxication during late adolescent and early adult years, whereas participation in team sports and endurance sports may reduce later increase in tobacco and cannabis use.

Keywords Alcohol, athletics, cannabis, prevention, prospective, sport, tobacco.

Correspondence to: Lars Wichstrøm, Department of Psychology, Norwegian University of Science and Technology, N-7491 Trondheim, Norway.
E-mail: lars.wichstrom@svt.ntnu.no

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INTRODUCTION

Sport is a major leisure activity among adolescents in most western countries. In Norway, 72% of adolescents reported that they were past or present members of a sports team [1]. It has been suggested that participating in sports during adolescence may prevent problem behaviour [2], and this contention also concurs with aetiological theories of such problems [3,4]. Problem behaviour denotes behaviour that is illegal or violates societal norms and includes crime, conduct problems, precocious sex during adolescence and drug use. In the present research we will address the latter, specifically alcohol intoxication, cannabis use and tobacco use. If indeed sports were preventive, existing sports organizations could be involved actively in interventions to prevent such drug

use. Moreover, because so many young people are involved in sports, sports participation could potentially be a major contributor to lowering the prevalence of drug use at the population level.

We argue that sport has at least five features that may affect the risk for young people's use of cannabis, tobacco and alcohol. (1) Social activity: most sports, both training and competition, are performed together with others. Thus, participating in sports may widen the participant's social network. Drug use, and alcohol use in particular [5], is a social activity. Hence, sports may therefore increase the risk of drug use. (2) Age segregation: during adolescence most sports competitions are held separately according to gender and age group. Whether training is separated accordingly may vary, but we contend that it is often the case. Participating in sports may thus increase

the probability of making same-aged and same-sexed friends. Associating with older adolescents increases the risk of smoking, drug use and alcohol intoxication [6], and sports participation may thus reduce the risk of substance use by means of reduced contact with older peers. (3) Time-spending: sports take time, in particular when the demands for making good results increase during adolescence. In many cases, the number of competitions also increases during adolescence. When the time spent on training and competing increase there is less time for other activities, among them activities associated with alcohol and drug use. (4) Adult supervision: mainly, adults coach and organize sports on behalf of adolescents. Besides, parents will often transport or accompany the adolescent to exercises and competitions, and parents may get to know their son or daughter's team members—and their parents, as well. This adult monitoring may limit problem behaviour [7]. (5) Orientation toward success: there is a close relationship between effort and results in sports. Smoking tobacco at a regular basis will reduce aerobic fitness, which is prerequisite in many sports. Hangover from alcohol consumption may also reduce physical ability. Alcohol intoxication and tobacco use may therefore jeopardize the ability to train effectively and results obtained during competition, and sports participation may thus limit substance use. The competitive aspect is expected to increase in importance during adolescence and to be more important to those competing at higher levels (e.g. international and national) than at lower levels (community and regional). In sum, theoretically, many but not all features of sports may reduce the risk of alcohol, tobacco and cannabis use.

Empirically, there have been numerous efforts to address the issue whether sports participation has a preventive effect. The overwhelming majority of studies are cross-sectional. Some of these show that adolescents involved in sports have higher alcohol consumption or more binge drinking than those not involved in sports [8–13], some show no correlation [14–17], whereas some show an alleged preventive effect [18–22]. Most studies find that adolescents participating in sports smoke less often than other adolescents (e.g. [8,18,23]). With respect to illicit drug use, some show less use among sports participators [12,20,24], whereas other show more prevalent use [22,25].

However, such a cross-sectional design is not well suited for answering this inherently aetiological question. The order of cause and effect in the relation between sports participation and substance use is equivocal. Substance use may increase the risk of not entering into sports or of quitting sports. To our knowledge, only five prospective studies exist. Pedersen [26] found that Norwegian adolescents who were members of a sports club had the highest level of alcohol intoxication of all types of

adolescent later on. No relation was found for cannabis use. Other studies are from the United States; Aaron *et al.* [27] found that the probability of future alcohol debut among male adolescents from Pittsburg, PA, with no alcohol experience increased with increasing level of physical activity—not necessarily within organized sports—and with sports competition. No such association was found for girls. Girls involved in leisure-time physical activity, however, were less likely than girls not physically active to initiate tobacco use. Sports participation among adolescents in South Florida increased the risk of adult alcohol use modestly [2]. However, this effect did not hold for African Americans and Hispanics. In addition, playing football among Caucasian young men increased the risk of later alcohol problems. Moreover, sports participation had a preventive effect for later illicit drug use among African Americans. Further, participation in sports at high school predicted post-high school alcohol use among girls from Maryland, but not boys [18]. Finally, Eccles *et al.* followed a sample of adolescents from Michigan into young adulthood, but found no direct effect of sports participation during late adolescence upon adult alcohol use [17].

Confounders

It should be noted that in many studies there is no systematic control for third variables. As shown by the studies of Aaron *et al.* [27], Fredricks & Eccles [18] and Eitle *et al.* [2], findings may vary according to gender and ethnicity. Both alcohol [28] and illicit drug use [29] increase with increasing age throughout adolescence and early adulthood. However, sports participation declines [30,31]. Thus, due to the age gradient alone, a seemingly preventive effect of sports participation may arise. Some of the apparently contradictory findings may be attributable to the varying influence of such confounders between studies. For example, the authors of one large nationally representative study from the United States concluded that sports participators had higher alcohol consumption than non-participators [10], whereas the results from another large-scale US study conducted in the same period did not find such an association [16]. However, the former studied college students and the latter senior high-school students, and the age differences between the two studies may explain this discrepancy. Several other potential confounders in the relationship between sports and substance use should be noted, as follows.

Family structure

Single parenthood increase the risk of substance use among the offspring [32] and it reduces the probability of

sports participation [33]. A negative association between sports participation and substance use may thus arise.

Pubertal timing

Prospective studies have shown that early pubertal timing increase the level of alcohol intoxication [6], tobacco use [34] and substance use [35], possibly through differential association with older friends. Those with early pubertal timing will be both taller and stronger than their age-mates. This will be an asset in competitions. During adolescence there is strong dropout from sports, particularly among girls [30]. Parts of this attrition may be due to less athletically successful adolescents leaving sports. The potentially better performance of the early-developing adolescents may thus prevent them from dropping out of sports. In consequence, a positive association between sports and alcohol intoxication may arise.

Friends' substance use

There are many reasons for joining a sports team or sports club, one of them is possibly that this is where one's friends are [36]. Similarly, quitting sports because friends do may be one of the reasons for leaving sports. There are strong prospective associations between peers' tobacco, alcohol and illicit drug use and the adolescent's own later use [37]. Thus, friends may introduce the adolescent to both sports and drugs. If there is indeed a lower rate of drug use among sports participators, the probability of being introduced to drugs is lower among sports participators than non-participators. Similarly, if drug use is more prevalent among sports participators, this will increase the risk of future drug use among sports participators who do not currently use drugs.

Grades

Adolescents who participate in sports have better grades than those who do not [38]. Moreover, drug use increases with decreasing grades [39]; hence, there may a negative spurious relation between sports and drug use that is attributable to grades.

Socio-economic status (SES)

Adolescents who have parents with high SES have been found to participate more often in organized sports than adolescents from lower SES families [40,41], albeit not always [42,43]. Smoking initiation in adolescence is strongly linked to low parental SES [44], and in Norway this is also the case for cannabis initiation [32] and alcohol use [45]; hence, SES may act as a confounder in the relationship between sports and drug use.

Social acceptance

There are indications that popular adolescents drink more often than less popular adolescents [28]. One explanation for this finding may be that popular adolescents have a wider social network and are therefore exposed more frequently to drinking opportunities, such as being invited to parties. Although not studied, it might be that adolescents who are involved in sports are more popular than adolescents who are not. There might be a variety of reasons for this, among them increased opportunity to gain new friends and conforming more often to the prevailing body ideal by greater slimness and muscularity (boys).

Type of sports

When studied, findings tend to vary according to aspects of the type of sport in question. Sports involvement has been found to predict later alcohol use, but only among those who were involved in American football (Caucasians only) [2]. Alcohol consumption varies not only by sports participation, but also by the degree of involvement [8,23] and the level of competition [46]. In a similar vein, associations have been shown to be stronger among team leaders than among ordinary team members [9]. There are reasons to believe that alcohol, cannabis and tobacco use vary with the skills needed in the sport practised. For instance, suffering from a hangover might be more detrimental to the performance of an adolescent involved in endurance sports than in an adolescent involved in power sports. Additional indications come from the study of anabolic androgenic steroids (AAS). Such studies have shown repeatedly that those involved in power sports are more frequently AAS users than others, and that AAS users both drink alcohol and use illicit drugs more often [47]. Thus, there is a need to investigate whether various aspects of sports influence the relationship between participation and substance use. We will study this with respect to the level of competition, the type of sport (team sports versus individual sports) and the predominant skills needed (endurance, power, technical sports).

In sum, we ask whether sports participation predicts future increase in smoking of tobacco, cannabis use and frequent alcohol intoxication, while controlling for potential confounders. Moreover, we will study whether these relationships vary according to level of competition, type of sport and the skills involved in the sport.

METHOD

Participants

Data for the present research stem from the Young in Norway Study [48,49]. The first testing was conducted in

Table 1 Demographics for males and females at T3 and T4; percentages.

	T3		T4	
	Males	Females	Males	Females
Labour marked position				
Student	41.3	48.7	11.0	12.0
Fully employed	35.7	28.7	75.9	52.4
Part-time work	7.7	14.7	8.9	13.0
Social welfare or unemployed	3.0	2.1	5.4	4.1
At home/housewife/maternity leave	1.0	5.3	0.7	16.7
Military service	11.2	0.4	0.1	0.0
Marital status				
Single	82.9	63.1	43.2	29.9
Married	2.0	4.3	19.4	26.7
Cohabiting	15.1	32.6	37.4	43.4
Living arrangements				
Alone	19.3	15.3	27.2	20.0
Parents	39.2	22.5	5.5	2.4
Romantic partner	15.3	33.8	56.3	69.4
Friends	17.8	20.5	8.4	4.4
Other	8.3	7.8	2.6	3.7

1992 (T1); 12 287 students in grades 7–12 (ages 12–20 years) from 67 schools representative of high schools in the country comprised the initial sample. Half the students were tested in the spring term and the other half in the autumn term, with a response rate of 97%. Three schools were included at T1 for non-prospective reasons and were not part of the follow-up. At one other school there was a burglary in the school's archives, and the project's identification records were lost. In all, 9679 students from 63 schools were eligible to complete the follow-up questionnaire (1994; T2). At T2 49.6% of the students had completed the 3-year track at junior or senior high school and therefore left the school they had attended at T1. This was the case for those students who completed the initial testing at junior or senior high school in their 9th or 12th grades or during the spring term of their 8th or 11th grades. Participants not in their original schools at T2 received the questionnaire by mail. The students still in their original schools completed the questionnaire at school according to the same procedure as in the initial survey (T1). Among those who were still at their original school, 92% responded compared to 67% in the postal study. Only students who completed the questionnaires at school at T2 ($n = 3844$) were followed-up at T3 (1999) due to the low response rate among those receiving the questionnaire by mail. Because the study was planned originally as a two-wave study, new informed consent had to be obtained at T2. Those consenting at T2 ($n = 3507$; 91.2%) received questionnaires by mail at T3. Data were received from 2924 participants (84%). Those consenting to follow-up at T2

were approached again in 2006 (T4) and 2890 participated (82.4%). In all, 3251 (92.7%) of those consenting to the extended follow-up participated at least at T3 or T4, and these form the basis of the present analyses. Two versions of the questionnaire were distributed randomly to each half of the study population at T1 and T2. Due to space limitations, detailed questions about sports (type, skills, level of competition) were covered in only one random half of the sample. The mean age of the participants was 15.0 years [standard deviation (SD) = 1.9] at T1, 16.5 years (SD = 1.9) at T2, 21.5 years (SD = 1.9) at T3 and 28.5 years at T4 (SD = 2.0). Table 1 presents demographic data from the sample at T3 and T4. As shown, almost half the sample were still students at T3, whereas the majority was in full-time or part-time work at T4. At T3 some of the males were conscripts—military service of 12–18 months is mandatory for young males in Norway. At T4 a sizable proportion of the women were at home. A 12-month maternity leave is granted to mothers in Norway and the high proportion of females staying at home was due mainly to this arrangement (13.1%).

Procedure

Every student gave his/her consent in writing based both on an oral and written description of the project formulated according to the standards prescribed by the Norwegian Data Inspectorate. According to these standards, written informed consent was also obtained from the parents of students below the age of 15. The students

were instructed to place the completed questionnaires in an envelope and to seal it themselves. It was made clear to the participants that by using this procedure the researchers would have access to their questionnaires but the researchers could not know their identity, whereas the school knew their identity but had no access to their questionnaire. A teacher trained by a liaison officer monitored the students in the class during completion. To avoid students influencing each other's responses, all eligible students at each school completed the questionnaire at the same time. Students who had consented to participate but who were not present in class during school that day completed the questionnaire together on a later occasion. At T3 and T4 participants received the questionnaire by mail. Those not responding within 4 weeks were mailed another questionnaire with a reminder letter.

Instruments

Sports participation

The adolescents were asked whether they had been training with a sports team during the preceding 7 days. For some students the surveying might take place off-season, and participants were therefore asked whether they were present or past members of a sports team. Those indicating that they were present members of a sports team or that they had trained with a sports team during the previous 7 days were considered to be involved in organized sports. The respondents were posed an open-ended question about whether they had competed in or were currently competing in any sports and to state the type of sport. Because adolescents may be involved in several sports, they were requested to list three sports at most, according to degree of involvement. The sport they were involved in most was used in the present analyses. The major sports at T1 were soccer (31.8%), team handball (18.2%), aerobics (6.0%), horse riding (3.8%), gymnastics (3.8%) and martial arts (3.5%). Those indicating weight-lifting, body-building, boxing, gymnastics, wrestling or martial arts were grouped as power sports participators. Endurance sports encompassed running, cross-country skiing, orienteering, speed skating and swimming. Other sports were considered technical. Those competing were requested to state the highest level at which they had competed (international, national, regional or community).

Substance use

The respondents were asked to indicate their use of cannabis and whether they had 'drunk so much that you felt clearly intoxicated', respectively, during the preceding 12 months. A six-point scale ranging from '0 times' to 'more than 50 times' was used for these ratings. The traditional

drinking culture in Norway is a somewhat explosive one, as is the case for most northern European countries and Nordic countries in particular. It is therefore more appropriate to address alcohol intoxication than consumption as in litres of alcohol. At T3 an additional question was posed about the number of binge drinking episodes (5+ alcohol units of 5 cl alcohol at one sitting) during the same 12 months, and the association between alcohol intoxication and binge drinking was strong, $r = 0.86$, $P < 0.0001$. The respondents were asked whether the extent to which they were current or past users of tobacco and to list the frequency of their use. A seven-point measure of tobacco use was created ranging from 'no current use' to 'daily use of 20 or more cigarettes per day'.

Family structure

Whether or not the adolescents lived in a two-parent household (one-parent, living on one's own, lodges, other family, etc.) was recorded.

SES

The parents' occupations were coded according to the International Labour Organization manual for occupations, ISCO-88 [50]. The father's occupation was used for coding of SES when he lived together with the adolescent; if not, the mother's occupation was used. The occupations were grouped into farmers/fishermen, manual workers, professional lower level, professional higher level and leaders.

Grades

Students reported their grades in maths, Norwegian and English, and a mean value was computed.

Pubertal timing

Pubertal timing was measured by one item [51,52]: 'When you look at yourself now, do you think that you are more or less physically mature compared to others (of the same sex) at your age?', using seven options ranging from 'much later' to 'much earlier'. The Pubertal Development Scale (PDS) [53] was administered to junior high school students at T1 and T2. PDS is a self-report measure of pubertal status that asks for ratings of the level of development on five pubertal indices of secondary sex characteristics. It should be noted that when age is controlled for, PDS approximates a measure of pubertal timing among early and middle adolescents. The raw correlation between PDS and the pubertal timing measure was 0.52, when corrected for disattenuation due to moderate reliability of PDS ($\alpha = 0.72$) the correlation

coefficient was 0.72, thus supporting the validity of our one-item measure of pubertal timing.

Friends' drug use

The respondents were asked to think about their two best friends and to record whether none, one or both of them got drunk at least once a week, had ever used cannabis and smoked tobacco regularly. A sum score of these three items was computed.

Analysis

The impact of sports participation on drug use was tested using latent growth curve analyses. In these analyses, two parameters are estimated for each person: the intercept of a construct and its slope. The intercept is a measure of the initial level of a construct for each person, whereas the slope indicates the person's overall change from T1 to T4. Correlated growth curves were modelled for sports participation, alcohol intoxication, cannabis use, tobacco use, social acceptance and friends' drug use. Tobacco use, friend's drug use and the subjects' own cannabis use were treated as ordered categorical variables. Participation in organized sports was treated as a binary variable (no participation = 0, participation = 1), whereas the skills required (endurance, strength or technical) were coded as dummy variables where technical sport was used as reference category. Growth was represented as yearly change. Slopes were regressed on all intercepts, age, gender, grades, family structure, SES and pubertal timing. The intercepts of alcohol intoxication, cannabis use, tobacco use, social acceptance and friends' drug use were regressed on the intercept of sports participation and the covariates (above). The model estimator yielded weighted least-square parameter estimates using a diagonal weight matrix with standard errors and mean and variance-adjusted χ^2 test statistics that use a full weight matrix (WLSMV). The WLSMV is robust to non-normality. An expectation-maximization method was used to handle missing data. Standardized coefficients are reported throughout. The analyses were performed in Mplus 5.1 [54].

RESULTS

About half the participants were active in organized sports at T1 (50.7%). More boys (56.5%) than girls (45.7%) were involved in sports. With respect to membership, almost half the adolescents were present members of a team at T1 (45.2%) and 31.8% stated that they were past members. The mean number of times the adolescents had trained or exercised during the previous 7 days at T1 was 3.00 times (SD = 2.84), excluding physical

education at school, including the 19.8% that had not exercised during these 7 days.

Table 2 shows the frequency of alcohol intoxication and cannabis use, respectively, and the level of tobacco use according to sports participation at T1. The frequency of drug use increased throughout the follow-up period. A strong increase was seen between T2 and T3 and then a levelling-off from T3 to T4. Those not involved in sports at T1 were intoxicated more often than sports participants at T1. However, at T3 and T4 those who were involved in sports at T1 were intoxicated more often than those who were not involved in sports at T1. With respect to cannabis use, sports participation was associated with lower use at T1 and T2, but not at T3 and T4. Regarding tobacco, sports participants scored lower on all occasions. It should be noted that although the number of smokers at T3 and T4 were approximately the same among sports participants at T1 and non-participants at T1, frequent use of tobacco was seldom seen among sports participants compared to non-participants.

A model of correlated growth curves for sports participation, alcohol intoxication, tobacco use, cannabis use, friends' drug use and social acceptance was estimated ($n = 3251$). Slopes were adjusted for all intercepts. This model showed that the intercept of sports participation predicted growth in alcohol intoxication ($\beta = 0.16$, $P < 0.001$), tobacco use ($\beta = 0.12$, $P < 0.001$) and cannabis use ($\beta = 0.08$, $P < 0.01$). The intercepts of the three types of substance use were related negatively to intercept of sports participation ($\beta = -0.23$, $\beta = -0.30$ and $\beta = -0.17$, respectively, all $P < 0.001$). However, adjusting for gender and age rendered the association between initial sports participation and tobacco use and cannabis use, respectively, non-significant, whereas an effect on alcohol intoxication remained ($\beta = 0.12$, $P < 0.001$).

Finally, the growth model, in addition to gender and age, was adjusted for family structure, SES, grades and pubertal timing. The model fitted the data well [$\chi^2 = 504.18$ (df = 126), comparative fit index (CFI) = 0.985, Tucker-Lewis index (TLI) = 0.983, root mean square error of approximation (RMSEA) = 0.020]. Table 3 shows the predictors of the respective slopes and Table 4 shows the predictors for the intercepts. As can be seen from Table 4, the intercept of sports participation was unrelated to the intercept of alcohol intoxication, whereas it did predict growth in alcohol intoxication during the study period (Table 3). A model with sports participation as the only predictor of growth in alcohol intoxication, except for age and gender, obtained regression coefficients for intercepts of sports participation that were not significantly different from the one in Table 3. Hence, there is no indication that the control variables acted as confounders.

Table 2 Frequency (%) of alcohol intoxication and cannabis use previous 12 months, and current tobacco use according to sports participation at T1.

	T1		T2		T3		T4	
	No sport	Sport						
Alcohol intoxication								
Never	61.4 (897)	68.0 (1020)	42.8 (636)	47.7 (725)	17.3 (232)	9.8 (135)	21.4 (285)	15.0 (205)
Once	7.3 (106)	7.9 (118)	9.8 (146)	8.8 (135)	7.2 (97)	5.5 (75)	7.7 (102)	7.8 (106)
2–5 times	11.8 (173)	11.0 (165)	18.0 (267)	18.4 (282)	20.4 (273)	22.6 (310)	23.7 (316)	24.0 (328)
6–10 times	6.6 (96)	4.9 (73)	10.4 (154)	9.9 (151)	16.0 (214)	16.8 (231)	17.6 (234)	17.7 (242)
11–50 times	10.9 (159)	7.3 (109)	16.0 (237)	13.1 (201)	31.4 (421)	37.0 (507)	23.8 (317)	29.0 (396)
50+ times	2.0 (29)	1.1 (16)	3.0 (45)	2.4 (36)	7.8 (104)	8.2 (113)	5.9 (79)	6.6 (90)
Cannabis use								
Never	95.3 (1389)	98.0 (1469)	92.4 (1371)	95.4 (1457)	83.6 (1098)	83.4 (1122)	86.8 (1146)	87.5 (1186)
Once	1.2 (18)	1.1 (16)	2.3 (34)	1.2 (18)	4.0 (52)	4.2 (57)	4.0 (53)	3.1 (42)
2–5 times	1.4 (21)	0.4 (6)	2.7 (40)	2.2 (33)	5.6 (73)	5.7 (77)	3.9 (51)	3.9 (53)
6–10 times	1.2 (17)	0.2 (3)	0.9 (13)	0.4 (6)	2.1 (27)	1.6 (22)	1.7 (22)	1.4 (19)
11–50 times	0.6 (9)	0.2 (3)	1.2 (18)	0.7 (10)	2.3 (30)	2.4 (32)	1.4 (19)	2.3 (31)
50+ times	0.3 (4)	0.1 (2)	0.5 (7)	0.3 (4)	2.6 (34)	2.6 (35)	2.2 (29)	1.8 (24)
Tobacco use								
No current use	75.1 (1098)	85.4 (1278)	69.2 (1044)	78.1 (1207)	57.4 (766)	60.3 (826)	68.8 (929)	70.1 (968)
Use, but not daily	10.5 (154)	8.0 (120)	10.7 (161)	11.0 (170)	12.7 (169)	15.5 (213)	8.9 (120)	11.7 (162)
Daily use <5 cigarettes	1.8 (26)	1.0 (15)	2.3 (35)	1.1 (17)	2.1 (28)	2.1 (29)	1.9 (25)	2.0 (28)
Daily use 5–9 cigarettes	3.2 (47)	1.9 (28)	5.4 (81)	3.0 (46)	6.5 (87)	4.5 (62)	3.6 (49)	3.5 (48)
Daily use 10–14 cigarettes	5.1 (75)	1.8 (27)	7.4 (111)	3.8 (46)	10.0 (134)	8.8 (120)	8.3 (112)	5.9 (81)
Daily use 15–19 cigarettes	2.3 (33)	0.8 (12)	3.2 (48)	2.1 (32)	4.9 (65)	4.6 (63)	4.3 (58)	4.3 (59)
Daily use 20+ cigarettes	2.0 (29)	1.1 (16)	1.9 (28)	1.0 (15)	6.4 (85)	4.2 (57)	4.3 (58)	2.5 (34)

Figures in parentheses are number of subjects.

Table 3 Predictors of 13-year growth in sports participation, alcohol intoxication, cannabis use, tobacco use, social acceptance and friends' drug involvement; standardized estimates (β).

	<i>Participation in organized sports</i>	<i>Alcohol intoxication</i>	<i>Tobacco use</i>	<i>Cannabis use</i>	<i>Social acceptance</i>	<i>Friends' drug involvement</i>
Intercept: participation in organized sports	-0.04	0.18***	0.14	0.13	0.10	0.15*
Intercept: alcohol intoxication	-0.22	-0.34***	-0.13	-0.16	0.06	0.05
Intercept: tobacco use	-0.16	0.22**	0.46**	0.60***	-0.26*	0.57***
Intercept: cannabis use	-0.38	0.11	0.53*	0.37	-0.34	0.68***
Intercept: social acceptance	-0.09	-0.01	-0.12*	-0.11	-0.34***	-0.11*
Intercept: friends' drug involvement	-0.03	-0.23	-0.70**	-0.76***	0.49*	-0.73***
Gender (female)	-0.24**	-0.23***	0.07	-0.15*	-0.03	-0.15***
Age	0.29	-0.25***	-0.22*	-0.03	-0.18	-0.32***
Grades at T1	-0.12	0.08**	-0.05	-0.02	-0.07*	-0.02
Living with both parents at T1	0.00	-0.01	-0.07	-0.14**	0.06	-0.09**
Early pubertal timing at T1	-0.01	-0.06*	-0.02	-0.03	-0.05	-0.01
Parental SES at T1	0.00	0.00	0.08	0.04	-0.07	0.08*
R ²	0.24	0.47	0.35	0.44	0.21	0.63

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. SES: socio-economic status.

Table 4 T1 predictors of level of sports participation, alcohol intoxication, cannabis use, tobacco use, social acceptance and friends' drug involvement; standardized estimates (β).

	<i>Participation in organized sports</i>	<i>Alcohol intoxication</i>	<i>Tobacco use</i>	<i>Cannabis use</i>	<i>Social acceptance</i>	<i>Friends' drug involvement</i>
Intercept: participation in organized sports	NA	-0.04	-0.21***	-0.26***	0.23***	-0.18***
Gender (female)	-0.13***	-0.01	0.01	-0.08**	0.01	0.00
Age	-0.37***	0.33***	0.13***	0.05*	0.14***	0.39***
Grades	0.09***	-0.19***	-0.19***	-0.13***	-0.03*	-0.17***
Living with both parents	0.05***	-0.10***	-0.11***	-0.10***	0.02	-0.10***
Early pubertal timing	0.02	0.12***	0.12***	0.12***	0.14***	0.10***
SES	-0.01	-0.05***	-0.01	-0.16***	-0.06***	-0.04***
R ²	0.20	0.24	0.24	0.20	0.07	0.36

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. NA: not applicable; SES: socio-economic status.

Several indirect effects of sports participation emerged. With respect to tobacco use, three indirect effects that all implied a reduction in tobacco use among sports participators were detected. First, the intercept of sports participation was related negatively to the intercept in tobacco use (Table 4), and the intercept in tobacco use predicted later growth in tobacco use (Table 3). There was hence a negative indirect effect of the intercept of sports participation on growth in tobacco use that was mediated through initial level of tobacco use ($\beta = -0.10$, $P < 0.01$). Secondly, the intercept of sport participation was also related negatively to the intercept of cannabis use, which in turn predicted growth in tobacco use. The result was also a negative effect from sports participation on tobacco use ($\beta = -0.14$, $P < 0.05$). Thirdly, the intercept of sport participation was associated positively with initial level of social acceptance (Table 4), which pre-

dicted a decline in tobacco use. The net result was also negative ($\beta = -0.03$, $P < 0.05$). In addition, this lower level of tobacco use among sports participators mediated a similar negative effect on the growth in cannabis use ($\beta = -0.13$, $P < 0.001$).

Boys had a stronger increase in alcohol intoxication and cannabis use than girls and they also had more friends who were involved with drugs compared to girls. As expected, higher age predicted reduced growth in alcohol intoxication and tobacco use, implying that those who were in early and middle adolescence at T1 had more growth in alcohol intoxication and tobacco use ahead of them than older adolescents. This was also reflected in a positive association between age and initial levels of substance use (Table 4). Adolescents living with both parents at T1 had less growth in cannabis use compared to adolescents not living with both parents.

The effect of sports participation was investigated further by focusing on those who were involved in sports. Sports participants were grouped according to their level of competition, the skills involved in their main sport and whether or not they pursued a team sport. With regard to skills involved, technical sports (75.4%) were far more prevalent than endurance sports (20.3%) and strength sports (4.2%). Team sports (66.2%) dominated over individual sports. Among those involved in competitive sports, 33.6% competed at a community level, 41.2% at a county level, 21.2% at a national level and 4.0% at an international level. A model was constructed in which growth in alcohol intoxication, tobacco use and cannabis use were predicted by these three sports characteristics, controlling for friends' initial drug involvement and initial social acceptance, gender, age, pubertal timing and residing with both biological parents ($n = 1576$). With respect to skills, involvement in technical sports was used as contrast. The resulting model fitted the data well (CFI = 0.984, RMSEA = 0.023). Those involved initially in endurance sports had lower growth in alcohol intoxication ($\beta = -0.06$, $P < 0.05$) and tobacco use ($\beta = -0.10$, $P < 0.01$) compared to those involved in technical sports. Those who were involved initially in team sports, however, had increased growth in alcohol intoxication ($\beta = 0.06$, $P < 0.05$), but reduced growth in tobacco use ($\beta = -0.09$, $P < 0.01$) and cannabis use ($\beta = -0.11$, $P < 0.01$).

DISCUSSION

The potential effect of participating in organized sports during adolescence on growth in alcohol, tobacco and cannabis use was investigated in a national representative sample of Norwegian adolescents who were followed-up after 2, 7 and 13 years. Controlling for a range of potential confounders, sports participation at the beginning of the study predicted growth in alcohol intoxication. Initial level of sports participation also predicted reduced growth in tobacco use via lower initial level of tobacco use, lower initial level of cannabis use and higher social acceptance. Initial sports participation was further linked to a later reduction in cannabis use through lowered tobacco use. Moreover, the characteristics of the sports seemed to have an impact on the growth in substance use, specifically whether one was involved in endurance sports versus technical sports or team sports, or not. Endurance sports and team sports had opposite effects on growth in alcohol intoxication; those involved initially in team sports had increased growth in alcohol intoxication, whereas those involved in endurance sports had reduced growth in alcohol intoxication. The effect on tobacco use was similar for team sports and endurance sports; both were related to reduced growth. Finally, team

sports participation predicted reduced growth in cannabis use. To our knowledge, this is the first study to apply a latent growth curve approach to the potential effects of sports participation on drug use.

Alcohol

Finding sports participation during adolescence to predict increases in alcohol intoxication is in accordance with some of the studies that have addressed this issue prospectively [2,26,42], but not all [17]. Moreover, Eitle *et al.* [2] found that those involved in American football were particularly susceptible to later alcohol problems. Although the major Norwegian sports, soccer and handball, differ in many respects from American football, they share the feature of training and competing together with a fairly stable group of same-aged peers. Keeping the collectivity of drinking in mind [5], having a large milieu within sports may increase the number of potential drinking opportunities [55]. The fact that those who were involved in team sports were the ones most at risk for increased alcohol intoxication concurs with this social influence explanation. The legal drinking age in Norway is 18 years, and obtaining alcohol through friends is therefore an important channel for those who are under age. Hence, having a large network established through sports may also enable the adolescent to obtain alcohol more easily. However, the results did not indicate that having more friends using drugs mediated the relationship between sports participation and drug use, because the effect of sports participation remained stable regardless of whether or not this factor was controlled for. It should be noted that we asked about the drug consumption among the two best friends, and such a question might not tap effectively the differential association with deviant peers. More detailed knowledge of the friends and their habits are needed [56]. First, we do not know if the two friends who were chosen belonged to the person's team-mates. Secondly, as the answers were limited to the drug habits of two people only, we neither gained information about the size and the level of drug use in the network nor the extent to which this network overlaps with the sports team. The fact that involvement in endurance sports predicted reduced growth in alcohol use may stem from the fact that most competitions in endurance sports will be held during weekends, as opposed to team-sport matches that are often run on weekdays. During adolescence, most alcohol intoxication will take place on Friday or Saturday nights. Endurance sports competitions are quite revealing in that the slightest reduction in physical capacity, such as a hangover, will be reflected in the results. Hence, involvement in endurance sports may increase the probability of abstaining from becoming intoxicated.

Tobacco and cannabis

There was no main effect of sports participation on growth in tobacco use, but the two intercepts were associated negatively. Further, because sports participators initially smoked less, used less cannabis and had higher scores on social acceptance there were negative indirect effects on growth in tobacco use. The current finding, that participation in organized sports predicted lowered growth in tobacco smoking, concurs with one study that has addressed this prospectively [42], and the fairly large body of cross-sectional studies. Smoking will reduce the aerobic capacity which is necessary in most sports. The gains achieved by aerobic training will therefore be compromised by smoking tobacco, and those smoking will have a competitive disadvantage. The overwhelming majority of adolescents and young adults will most probably know this, and this fact may prevent them from taking up smoking, not smoking regularly, or even quitting smoking. The strong association between endurance sports involvement and reduced growth in tobacco use support this. Even the major team sports in Norway, such as soccer and team handball, have a definite aerobic aspect to them, making the reduction in performance aspect of smoking relevant for them as well.

Cross-sectional findings concerning sports participation and illicit drug use have been equivocal, and the only prospective study of these relationships found evidence of sports being predictive [18]. The present results concur with the latter study, in finding that sports participation as such is unrelated to growth in cannabis use. However, because sports participators tend to smoke tobacco less often than non-participators the present study underscore that this may, in fact, reduce the probability of smoking cannabis, which should also be predicted from a gateway theory of substance initiation [57].

The effect of sports participation also varied with the type of sports in question: those involved in team sports were likely to have a lower growth in cannabis use compared to other sports participators. At first sight it might appear paradoxical that team sports participation increases the risk of later alcohol intoxication, but decreases the risk of later tobacco use and cannabis use, considering the high intercorrelations between such problem behaviours [7]. It should be noted that the frequency of intoxication increases dramatically during adolescence and frequent alcohol intoxication prevails into early adulthood. At the beginning of the study more than half the participants, then being adolescents, had never been intoxicated during the past year. However, among young adults, not being intoxicated at least sometimes was quite infrequent. To get drunk among late adolescents and young adults is thus almost normative in Norway. Cannabis use, however, still has a very low

prevalence in adult years. Hence, it might be that team sport participation fosters socialization into normative behaviour [13], which is getting drunk—but abstaining from illicit drugs. It may also be argued that those who take up sports are more conventional from the outset, and that conforming to the norm is not a result of socialization. First, the correlations between personality traits and sports participation are small, and the strongest is found generally for extraversion (e.g. [58]). Secondly, if personality factors did play a role one should expect these, first and foremost, to influence the level of drug use, whereas the important finding in this work was that further growth in drug use was predicted by sports participation when the initial level of drug use was controlled for. However, it is still possible that unmeasured 3. variables account for the associations between sports participation and changes in drug use.

It should be noted that some of the associations between sports participation and the growth in use of alcohol, tobacco and cannabis were small. This should not be surprising, as there are numerous other important influences on the development of drug use, and that moderately strong associations already existed between sports participation and drug use at the start of this study. Further, as sports participation is so prevalent, we should not expect a strong influence on drug use. However, for the same reason sports participation has a potential influence on a large number of young peoples' future drug use.

Limitations

The present research had several advantages compared to previous studies, among them a longitudinal design, a large national probability sample and measures of a comprehensive set of potential confounders. Several limitations should still be acknowledged.

First, although the initial participation rate and the retention rates were favourable, the cumulative participation rate in multiple-wave surveys most often suffers, as was the case in this study. Importantly, the attrition was not selective on vital variables, except that the attrition group contained somewhat more daily smokers. The focus of this study was, however, not on prevalence, but on prospective associations. It is much more unlikely that associations are different among those dropping out of the study compared to those who remained, namely interacting with attrition, but this possibility cannot be ruled out.

Secondly, the present study addressed participation in organized sports and not physical activity in general. This is in keeping with the view that the adoption of substance use is a social process [5,37]. However, the implication is that these findings do not necessarily extend to physically active youth who are not performing their activity within an organization.

Thirdly, the Norwegian scene differs in several respects from many other western countries. The participation rate in organized sports is high; 77% were present or past members of a sports team. The sports played will be comparable to other northern European countries, soccer and team handball dominating among both boys and girls. This differs from the United States, where gender differences in the types of sports played are more pronounced, and with male sports having a greater emphasis on strength (American football and to some extent baseball) than on endurance. It is also important to note that in Norway sports are organized outside the school system. Independent community-based sports teams prevail within the Norwegian Confederation of Sports/Norwegian Olympic Committee. Coaches will come from the local community and are not generally paid for their services. Moreover, the prevalence of cannabis use will be lower than in most countries, and the rate of alcohol intoxication will be higher [6]. Hence, the present findings may be representative of northern European countries, but do not necessarily extend to other countries. Finally, although a prospective design was employed, the present study is still a correlational one. Even if several suspected confounders were controlled for, a list of potential confounders cannot be all-embracing. The reported estimates thus merely indicate possible causality.

Declarations of interest

None.

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