



Sport participation and alcohol and illicit drug use in adolescents and young adults: A systematic review of longitudinal studies



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HIGHLIGHTS

- Systematic review of longitudinal and intervention studies.
- Sport participation was associated with increased use of alcohol use.
- Sport participation was associated with reduced illicit drug use during adolescence.
- Limited attempts have been made to reduce alcohol and drug use through sport participation.

ARTICLE INFO

Keywords:

Sport participation
Substance use
Alcohol
Drugs
Adolescence
Youth

ABSTRACT

Sport participation can play an important and positive role in the health and development of children and youth. One area that has recently been receiving greater attention is the role that sport participation might play in preventing drug and alcohol use among youth. The current study is a systematic review of 17 longitudinal studies examining the relationship between sport participation and alcohol and drug use among adolescents. Results indicated that sport participation is associated with alcohol use, with 82% of the included studies (14/17) showing a significant positive relationship. Sport participation, however, appears to be related to reduced illicit drug use, especially use of non-cannabis related drugs. Eighty percent of the studies found sport participation associated with decreased illicit drug use, while 50% of the studies found negative association between sport participation and marijuana use. Further investigation revealed that participation in sports reduced the risk of overall illicit drug use, but particularly during high school; suggesting that this may be a critical period to reduce or prevent the use of drugs through sport. Future research must better understand what conditions are necessary for sport participation to have beneficial outcomes in terms of preventing alcohol and/or illicit drug use. This has been absent in the extent literature and will be central to intervention efforts in this area.

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Contents

1. Introduction	498
2. Methods	498
2.1. Selection of studies	498
2.2. Sample selection	498
2.3. Data extraction and reporting	499

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3.	Results	499
3.1.	Sampling composition of included studies	499
3.2.	Effect of sport participation on alcohol use	499
3.2.1.	Effect of sport participation on alcohol use: length of follow-up	499
3.2.2.	Moderating factors of sport participation on alcohol use	501
3.2.3.	Differing types of sport participation and alcohol use	501
3.3.	Effect of sport participation on illicit drug use	501
4.	Discussion	501
4.1.	Alcohol use	503
4.2.	Illicit drug use	503
4.3.	Limitations within the current literature	504
4.4.	Future directions	504
4.5.	Conclusion	505
	Role of funding sources	505
	Contributors	505
	Conflict of interest	505
	Acknowledgments	505
	References	505

1. Introduction

Sport participation can play an important and positive role in the health and development of children and youth (Donnelly, Darnell, Wells, & Coakley, 2007). There is, however, also the recognition of the potentially damaging effects that sport participation can have on children and youth (e.g., excessive demands and expectations that exceed one's physical and/or emotional maturity, negative adult involvement, risk of injury American Academy of Pediatrics, 2001). One area that has recently been receiving greater attention is the role that sport participation might play in preventing drug and alcohol use among youth.

To date, several systematic reviews have been published on the association between sport participation (primarily with respect to organized high school and collegiate sports) and alcohol, tobacco, and illicit drug use (Diehl et al., 2012; Lisha & Sussman, 2010; Martens, Dams-O'Connor, & Beck, 2006; Mays, Gatti, & Thompson, 2011). Collectively, the reviews suggest that sport participation is associated with a lower use of tobacco and illicit drugs during adolescence, but that it tends to be associated with an increased use of alcohol. There is also some evidence suggesting that the effect of sport participation on drug and alcohol use may vary by gender, race, and the kind or type of sport. For example, Ewing (1998) found that male athletes are more likely to use marijuana than male non-athletes; and in comparison to female non-athletes and males (athletes and non-athletes), female athletes had the lowest rates of marijuana use. Another study by Ford (2007) found a sport-specific effect in relation to marijuana use: male hockey players and female soccer players have the highest rates of use, while cross-country and track athletes (male and female) have the lowest. This suggests that a simple, uniform positive effect of sports on substance use is unlikely, and the impact of participation will be dependent on both the substance and activity in question.

While these reviews are informative, there are several limitations that necessitate further work. First, sport participation in these reviews was often narrowly limited to education contexts (e.g., high school, college), and therefore failed to include sport participation in other settings (e.g., community recreational programs). As a result, the focus has been on high school and university student athletes to the exclusion of younger children and youth, particularly between the ages of 10 and 14 (e.g., peri-adolescence). This is an important limitation given research that suggests that children and youth in this age range have already begun to use alcohol and drugs (Paglia-Boak, Adlaf, & Mann, 2011). Furthermore, the peak time for sport participation for most individuals is during peri-adolescence and adolescence, after which participation tends to decline during the transition into early adulthood and throughout the life-course thereafter (Sport England, 2004). Since existing

research tends to exclude children and youth at exactly the time when both use of alcohol and drugs emerges, and when sport participation is highest, it remains unclear whether sport participation offers any protective effect for children and youth. Second, and perhaps more importantly, the vast majority of studies reviewed have been cross-sectional. As a result, temporal associations have not been well characterized. For example, while it appears that athletes may be more likely to drink than non-athletes, it is unclear if this persists over time. Moreover, it is not known if stable (i.e., long term) participation in sport reduces the frequency of alcohol consumption relative to those who drop out of sports, and those who never participated at all. From the perspective of prevention, longitudinal studies are critical because they can only be used to establish causation. In order to address these limitations, we conducted a systematic review focused specifically on longitudinal studies that examined the impact of sport participation on alcohol and illicit drug use during the broader transition from early adolescence through early adulthood.

2. Methods

2.1. Selection of studies

In order to ensure broad based, multi-disciplinary coverage of the association between sport participation (elite and non-elite) and alcohol, and illicit drug use, we searched the following electronic databases: Ovid MEDLINE(R); Ovid EMBASE; OVID psycINFO; EBSCO SPORTDiscus; Cochrane Central Database; and Web of Science. Using a similar method to previous reviews (Diehl et al., 2012; Lisha & Sussman, 2010), these databases were searched with combinations of the following terms: "sports", "sport participation", "sport-type"; "organized sports"; "substance use"; "substance abuse"; "drug use"; "alcohol"; "alcohol use"; "alcohol abuse"; "addiction"; "drug addiction"; "opiates"; and "illicit drugs". As there is no way to filter for age range, due to inconsistencies in age reporting across studies, we also crossed these search terms with "adolescence" and "adolescents" to help narrow the search parameters. We purposively did not include search terms for specific methods (e.g., longitudinal) to ensure comprehensiveness. The search took place between December 19th, 2012 and February 28th, 2013, and only included all published articles in print and/or electronic form between January 1st, 1982 and December 31st, 2012.

2.2. Sample selection

We only selected studies published in English. Single case studies, reviews (including book chapters), and studies that did not report

quantitative results were excluded. Two reviewers (SB, MK) independently conducted the electronic searches using the aforementioned databases. Together, independent review of these electronic databases identified a total of 1451 articles with the initial search terms, which were then examined by each reviewer for eligibility. After removing the duplicate articles, a total of 72 articles, which examined the relationship between sport participation and alcohol and/or drug use, were identified as potentially relevant articles. A manual reference search of the 72 articles was then conducted, which resulted in the identification of an additional 70 articles to be further scrutinized. Upon closer examination of the 142 articles identified by the two reviewers, there was consensus that 14 of those studies met the study inclusion criteria. It is important to note that 90% of the studies that were identified were cross-sectional studies, and thus excluded.

2.3. Data extraction and reporting

A standardized form was created for data extraction. Two authors (JC, MK) used the form to independently extract the data from 14 longitudinal studies, which was subsequently checked for comparability. Next, we contacted all of the lead study authors of these 14 studies, plus two additional content experts, to check if they were aware of relevant articles missed in the search. In total, 11 of the 16 (69%) authors contacted responded to our query. This resulted in an additional two studies being identified and included in the review. Finally, we performed a gray literature search using Google Scholar, which led to an additional study not identified through earlier searches or by the

content experts. The complete process of identification, inclusion, and exclusion of the articles included is shown in Fig. 1.

3. Results

3.1. Sampling composition of included studies

In total, the systematic review included 17 longitudinal studies, all of which were observational studies (e.g., prospective cohort). The vast majority of the longitudinal studies identified were conducted in the United States (16 of 17; 94%), with a lone study being conducted in Norway (Wichstrom & Wichstrom, 2009). It should also be noted that only nine of these studies (53%) were included in previous reviews (Diehl et al., 2012; Lisha & Sussman, 2010; Mays et al., 2011). Participants in the longitudinal studies were sampled using a variety of different methods: four studies (24%) used convenience samples (Aaron et al., 1995; Crossnoe, 2002; Darling, 2005; Sher & Rutledge, 2007); five studies (29%) used participants from a cohort study that may or may not (i.e., unable to determine from article) have used a probabilistic sampling method (Barber, Eccles, & Stone, 2001; Eccles & Barber, 1999; Eitle, Turner, & Eitle, 2003; Fredricks & Eccles, 2006; Peck, Vida, & Eccles, 2008); and nine studies (47%) used data representative of their target population (Dawkins, Williams, & Guilbault, 2006; Fauth, Roth, & Brooks-Gunn, 2007; Hoffmann, 2006; Mahoney & Vest, 2012; Mays, DePadilla, Thompason, Kushner, & Windle, 2010; Miller et al., 2003; Terry-McElrath & O'Malley, 2011; Wichstrom & Wichstrom, 2009).

The duration of the studies reviewed ranged from six-months to 16-years in total length, and included between one-to-four follow-up assessments. Among these longitudinal studies, eight studies (47%) were considered short-term (6-months to 4-years in length), which primarily focused on the late adolescent period (i.e., during high school) (Aaron et al., 1995; Crossnoe, 2002; Darling, 2005; Dawkins et al., 2006; Eccles & Barber, 1999; Fredricks & Eccles, 2006; Hoffmann, 2006; Sher & Rutledge, 2007); and nine studies (53%) were considered long-term (6-to-16 years), which focused on the broader transition from peri-adolescence into early adulthood (i.e., 12 to 28 years of age) (Barber et al., 2001; Eitle et al., 2003; Fauth et al., 2007; Mahoney & Vest, 2012; Mays et al., 2010; Miller et al., 2003; Peck et al., 2008; Terry-McElrath & O'Malley, 2011; Wichstrom & Wichstrom, 2009). Study characteristics of short and long-term follow-up studies are presented in Tables 1 and 2, respectively.

3.2. Effect of sport participation on alcohol use

Overall, there is consistent evidence to suggest that sport participation is positively associated with alcohol use. A total of 14 studies (82%) found a positive relationship between sport participation and alcohol use (i.e., sport participation associated with increased alcohol use) (Aaron et al., 1995; Barber et al., 2001; Crossnoe, 2002; Dawkins et al., 2006; Eccles & Barber, 1999; Eitle et al., 2003; Fauth et al., 2007; Fredricks & Eccles, 2006; Hoffmann, 2006; Mays et al., 2010; Peck et al., 2008; Sher & Rutledge, 2007; Terry-McElrath & O'Malley, 2011; Wichstrom & Wichstrom, 2009), while only three studies (18%) reported no significant relationship (positive or negative) (Darling, 2005; Mahoney & Vest, 2012; Miller et al., 2003). Upon closer investigation, however, there is some evidence that the strength of this relationship may in part be influenced by the timeframe in which sport participation was measured, the potential modifying effects of socio-demographic factors, and the type of sport.

3.2.1. Effect of sport participation on alcohol use: length of follow-up

The findings from the short-term studies were largely consistent, suggesting that sport participation is strongly associated with increased alcohol use during the late adolescent period. With the exception of Darling (2005), all short-term studies found a significant positive relationship between sport participation and alcohol use. However, because

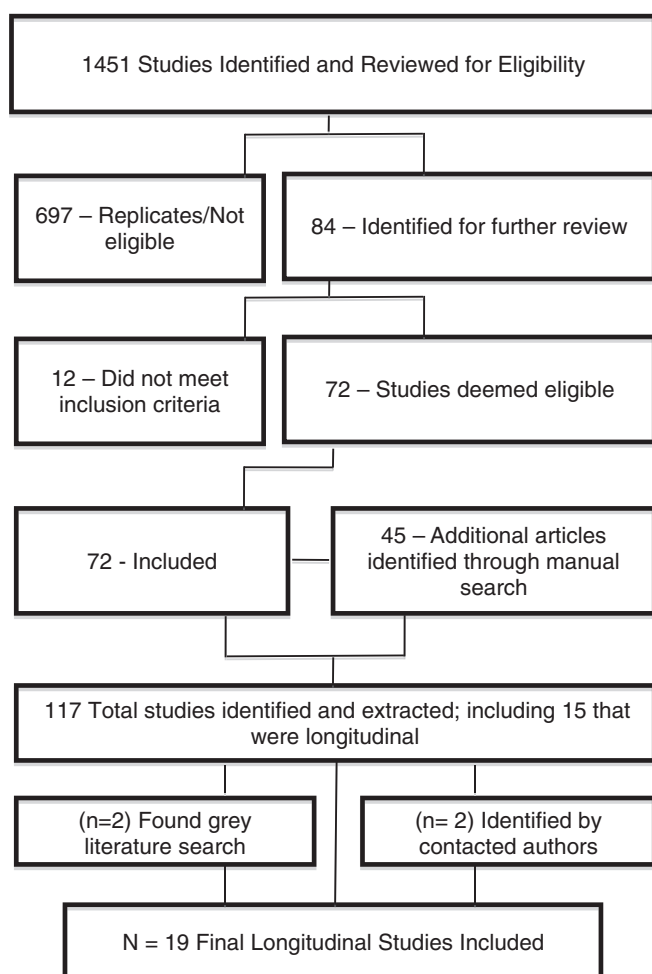


Fig. 1. Review process and results.

Table 1
Study characteristics and findings from short-term studies (N = 8).

Study	Sample	Measures used	Primary findings
Physical activity and the initial high-risk health behaviors in adolescents Aaron et al. (1995)	N = 405 (49% female); convenience sample of junior high school students (12–16 years of age at baseline); follow-ups at 1 & 4 years from baseline.	<i>Sport participation:</i> Binary measure at baseline: a question asked “did you participate in competitive athletics during the previous year?” <i>Alcohol use:</i> During the past 12 months, on how many occasions have you used alcohol? Responses ranged from (1) none to (7) 40 or more times.	Males participating in competitive athletics were significantly more likely to initiate alcohol usage at the 3-year follow-up than males that did not. No differences in changes in marijuana use based on athletic participation.
Academic and health-related trajectories in adolescence: The intersection of gender and athletics Crossnoe (2002)	N = 2651 (53% female); convenience sample of high school freshman and sophomore students tracked annually over 3 years during high school.	<i>Sport participation:</i> Binary measure of sport participation at baseline was used. If they reported engaging in any sport activities, they were considered athletes. <i>Alcohol use:</i> Since the beginning of the school year, how often have you used alcohol excessively or been drunk? Responses ranged from (1) never to (4) often. <i>Marijuana and other illicit drug use:</i> Since the beginning of the school year, how often have you smoked marijuana or used a drug other than marijuana? A composite score was created to reflect drug use, ranging from (1) never to (4) often.	There was an overall increase in substance use over the 3-year period (alcohol and illicit drug use were measured together). There was a general increase in alcohol use over time; however, female non-athletes had a lower growth in alcohol use compared to male non-athletes. Male and female athletes had similar growths in alcohol use as male non-athletes. Regardless of athletic status, females had lower growth in illicit drug use during high school compared to males.
Participation in extracurricular activities and adolescent adjustment: cross-sectional and longitudinal findings Darling (2005)	N = 3427 (48% female); convenience sample of grade 9 and 10 students, re-assessed annually until they were in grades 11 and 12.	<i>Sport participation:</i> Each year, participants were asked whether they had participated in each of 21 different extracurricular activities, including intramural sports. Participation was defined as engaging in this for each year. <i>Alcohol use:</i> Since the beginning of the school year, how often have you used alcohol? Responses ranged from (1) never to (4) often. <i>Marijuana and other illicit drug use:</i> Since the beginning of the school year, how often have you smoked marijuana; used a drug other than marijuana? Responses ranged from (1) never to (4) often.	There were no significant differences between extracurricular activities, which includes intramural sports, and alcohol use during high school. More years involved in extracurricular activities, including intramural sports, were significantly associated lower use in marijuana use and other drugs.
Participation in school sports: risk or protective factor for drug use among black and white students? Dawkins et al. (2006)	N = 1052; students participating in the National Educational Longitudinal Survey during grades 10 and 12.	<i>Sport participation:</i> Count measure of sport participation: The cumulative years participants played sports from grades 10 to 12. <i>Alcohol use:</i> On how many occasions during 12th grade did you use alcohol? Responses ranged from (0) – none to (3) 20 or more times. <i>Marijuana use:</i> On how many occasions in 12th grade did you use marijuana? Responses ranged from (0) – none to (3) 20 or more times.	Sport participation during high school was positively associated with alcohol use during the students' final year in high school. The positive relationship between and sport participation and alcohol use were among white athletes only; sport participation was negatively associated among black female athletes. Sport participation was negatively associated with marijuana use during students' final year in high school.
Student council, volunteering, basketball, or marching band: what kind of extracurricular involvement matters Eccles and Barber (1999)	N = 1256 (54% female); a sample from the Michigan Study of Adolescent Life Transitions, completing assessments in grades 10 and 12.	<i>Sport participation:</i> Binary measure at baseline: participation in one or more team sports (among a list of 16 sports). <i>Alcohol use:</i> How often in the past 6 months have you: [drink alcohol; were drunk]? Responses ranged from (1) none to (8) 31 or more times. <i>Marijuana and other illicit drug use:</i> How often in the past 6 months have you used: [marijuana/ hard drugs]? Responses ranged from (1) none to (7) 21 or more times.	Participation on a sport team was significantly associated with drinking alcohol in grade 10 and binge drinking during the last year of high school. There were no differences in the use of marijuana or hard drugs for students in grade 12 sport participation in grade 10.
Extracurricular involvement and adolescent adjustment: impact of duration, number of activities, and breadth of participation Fredricks and Eccles (2006)	N = 508 (54% female); participants were from three cohorts (grades 7, 8, 10) from the Childhood and Beyond Study were followed for three years; including two follow-up periods.	<i>Sport participation:</i> A count measure of sport participation: a list of community and school sports participation over the past year. <i>Alcohol use:</i> How many times in the past 30 days have you drank alcohol (beer, wine, and liquor)? Responses ranged from (0) never to (5) 21 or more.	There was a positive association between sport participation (years in sports) and alcohol use during students' final year of high school.
Extracurricular activities, athletic participation, and adolescent alcohol use: gender-differentiated and school-contextual effects Hoffmann (2006)	N = 9893 (55% female); national-probability sample of high school students in grade 10, and they were re-assessed when in grade 12.	<i>Sport participation:</i> A count score of the following sports they participated in: softball/baseball; basketball; football; soccer; swim sports; other team sports; other individual sports. <i>Alcohol use:</i> In the last 12 months, how many times did you do the following: drink alcohol and binge drink? Responses ranged from (0) no occasions to (3) 20 or more occasions, summed to reflect alcohol use in the past year.	There was a positive relationship between athletic activities and increases in alcohol uses during high school for both males and females. Each 1% increase in sport participation was related to an 8% increase in alcohol use. The relationship between sport participation and alcohol use is stronger among schools in lower SES communities and in schools with high minorities for males, whereas, sport participation is negatively associated with alcohol use among females in lower SES schools.

Table 1 (continued)

Study	Sample	Measures used	Primary findings
Heavy drinking across the transition to college: Predicting first-semester heavy drinking from pre-college variables Sher and Rutledge (2007)	N = 3720 (61% female); convenience sample of freshman students first entering college and followed-up after their first semester.	<i>Sport participation</i> : Binary measure of participation in either interscholastic sport teams or in intramural athletics <i>Alcohol Use</i> : A measure of heavy drinking was assessed as summed count of: past 30-day frequency of being high/light-headed, being drunk, and engaging in binge drinking (i.e., drinking 5 or more times at a sitting).	There were significant increases in heavy drinking from pre-college to the first semester of college.

Darling (2005) considered sport participation together with other extracurricular activities, the independent effect of sport participation cannot be determined.

Findings from the long-term studies also suggest that sport participation appears to be positively associated with alcohol use. There were two long-term studies (22%) that did not find a significant relationship between adolescent sport participation and alcohol use (Mahoney & Vest, 2012; Miller et al., 2003). Both of these studies, however, measured alcohol use at follow-up six-years later – which could be too long between assessments to capture meaningful associations. Importantly, 80% of the studies (4 of 5) found sport participation during the peri-adolescent period being indeed positively related to increased alcohol use during late adolescence and into early adulthood.

3.2.2. Moderating factors of sport participation on alcohol use

While several socio-demographic factors such as gender, age, ethnicity, and socioeconomic status were included in multivariate models as confounding factors, some variables were also examined as moderators. There were three studies that found a significant gender by sport participation interaction (Aaron et al., 1995; Barber et al., 2001; Crossnoe, 2002). The effect of gender, however, was not consistent across the studies. While studies by Barber et al. (2001) and Crossnoe (2002) found that female athletes reported greater increases in alcohol use in comparison to female non-athletes and males in general, the study by Aaron et al. (1995) found a significantly higher proportion of male athletes being alcohol users compared to male non-athletes, and no differences for females regardless of being an athlete or not. There was one study that found a moderating effect of race on sport participation. Results from Eitle et al. (2003) initially found sport participation being associated with alcohol use during late adolescence but not during early adulthood. After stratifying the analyses by race, sport participation in adolescence was related to alcohol use during early adulthood among white athletes only. Hoffmann (2006) was interested in the interactions between sport participation, race, and socioeconomic status. While there was no interaction between race and sport participation, they found a significant interaction between sport participation and socio-economic status. Specifically, the findings suggest that sport participation was associated with increased overall alcohol use during high school, but that the relationship appeared stronger for youth living in higher (versus lower) socio-economic neighborhoods. Despite the small number of studies examining the moderating impact of gender, race and SES, and conflicting results at least with regard to gender, there is at least provisional evidence that the effect of sport participation on alcohol use is conditional on these factors.

3.2.3. Differing types of sport participation and alcohol use

Only one study in our review investigated the impact of different types of sport on alcohol use, Wichstrom and Wichstrom (2009) constructed latent growth curve models to predict the use of alcohol based on sporting type (team vs. individual) and skill involvement (technical sports vs. endurance sports vs. strength sports). Their results suggest that youth in technical sports has greater growth in alcohol use (increasing over time) compared to those who participate in endurance

sports. Similarly, participants in team sports have greater growth in alcohol use compared to those who participate in individual-based sports.

3.3. Effect of sport participation on illicit drug use

The evidence for the relationship between sport participation and the use of marijuana was somewhat mixed. A total of 11 studies (65%) assessed the use of cannabis or marijuana; however, three of these studies included the use of marijuana use as a part of a composite score (i.e., marijuana included along with other substances) to reflect participants' overall substance use (Crossnoe, 2002; Eitle et al., 2003; Fauth et al., 2007). Although all of these studies found a positive relationship between sport participation and substance use, it was not possible to parse out the specific effect on marijuana use. Among the eight studies (47%) that examined marijuana use independently, four (50%) found a significant negative relationship with sport participation (Barber et al., 2001; Darling, 2005; Dawkins et al., 2006; Terry-McElrath & O'Malley, 2011) – suggesting that adolescents who engage in sports are less likely to be users of marijuana. The other four studies (50%) did not find a significant relationship between sport participation and marijuana use (Aaron et al., 1995; Eccles & Barber, 1999; Mahoney & Vest, 2012; Wichstrom & Wichstrom, 2009). A closer evaluation of these studies revealed that the studies finding a positive effect for sport participation were focused largely on marijuana use during high school, whereas the studies that did not find a relationship assessed cannabis use while the participants were well into their 20s.

A total of five studies (29%) examined the use of illicit drugs independent of marijuana use. Eighty percent of these studies found a significant inverse relationship between sport participation and drug use (Barber et al., 2001; Darling, 2005; Eitle et al., 2003; Terry-McElrath & O'Malley, 2011): Youth who participate in sports are less likely to be illicit drug users. Eccles and Barber (1999) was the lone study that did not find a significant association between sport participation and drug use. Overall, it appears that 64% of the studies (7 of 11) found a significant negative association between sport participation and overall illicit drug use, suggesting that sport participation may protect against drug use. The results did not appear to differ based on short-term or long-term studies; however, it should be noted that several long-term studies found that the negative relationship was stronger during late adolescence compared to early adulthood (Barber et al., 2001; Eitle et al., 2003; Peck et al., 2008; Terry-McElrath & O'Malley, 2011).

4. Discussion

Although there is a growing body of literature examining the association between sport participation and alcohol/illicit drug use during childhood and adolescence, remarkably few studies are based on longitudinal data (17 of 142 studies; 12%), and include only a handful that examined the peri-adolescent period (5 of the 17 studies; 29%). Furthermore, our search revealed no randomized controlled or treatment-control group studies to assess the efficacy or effectiveness of sport participation in terms of overall use or prevention of alcohol or illicit drug use among youth. While there is compelling evidence suggesting that sport

Table 2
Study characteristics and findings from long-term studies (N = 9).

Study	Sample	Measures used	Primary findings
Whatever happened to the jock, the brain, and the princess? young adult pathways linked to adolescent activity involvement and social identity Barber et al. (2001)	N = 900; convenience sample of high school students transitioning into early adulthood (aged 16 at baseline). There were 3 subsequent follow-up assessments 2, 5, & 9 years later.	<i>Sport Participation</i> : Binary measure at baseline: participation was defined as engaging in one or more school team sports. <i>Alcohol use</i> : Frequency of use during the previous 6 months. Responses ranged from (1) none to (7) \leq 21 times. <i>Marijuana use</i> : During the past 12 months, on how many occasions have you used marijuana? Responses ranged from (1) none to (7) 21 or more times.	Sport participation was positively associated with increases in alcohol use over time. A significant gender by sport by time interaction suggests that female athletes increased their frequency of alcohol use at a faster rate than non-athlete females, while male athletes had a slower rate of increase compared to male non-athletes. Athletes reported increases in marijuana use throughout high school but their rates stabilized in their early adulthood. Non-athletes had similar increases throughout high school, and their stabilization rates occurred later in adulthood.
The deterrence hypothesis re-examined: sport participation and substance use among young adults Eitle et al. (2003)	N = 1230 (26% female); a subsample of a large cohort study with a representative sample from the South Florida Study, aged 18 & 23 at baseline and re-assessed 8 years later.	<i>Sport participation</i> : A retrospective measure of sport participation during high school (a list of 16 sports). <i>Alcohol use</i> : A series of questions asking about past year alcohol use (e.g., highest number of drinks consumed, frequency of drinking, frequency of getting drunk, etc.): n index constructed to reflect usage. <i>Marijuana and other illicit drug use</i> : How often did you use the following of these illegal substances: [sedatives, amphetamines, analgesics, tranquilizers, inhalants, marijuana, cocaine, hallucinogens, and heroin]? Each response was on a 7-point scale ranging from (1) none to (8) 40 or more times. A count score was used to reflect total drug use.	Sport participation during high school was positively associated with alcohol use during early adulthood for white/Caucasian athletes only. Sport participation was negatively associated with the use of illicit drugs during high school. There was a negative association between sport participation and illegal drug use among African Americans when they reached early adulthood.
Does the neighborhood context alter the link between youth's after-school time activities and developmental outcomes? a multilevel analysis Fauth et al. (2007)	N = 1315 (51% female); a cohort of 9 and 12 year old children (drawn from a sample using multi-stage probability sampling), followed over a 6-year period.	<i>Sport participation</i> : Binary variable asking participants whether they engaged in one of five after-school time programs (including specified sports or cheerleading). <i>Composite substance use (alcohol and marijuana)</i> : The number of times in the month prior they had drank alcohol or had used marijuana. Responses for each ranged from: (0) never to (3) more than 6 times.	Sport participation at baseline was associated with greater substance use at 3- and 5-year follow-ups, and associated with greater and substance use over time.
The over-scheduling hypothesis revisited: intensity of organized activity participation during adolescence and young adult outcomes Mahoney and Vest (2012)	N = 1115 (51% female); nationally-representative sample of adolescents 12-to-18 at baseline, and they were reassessed when they were 18-to-24.	<i>Sport participation</i> : Binary measures of organized sport activities (yes/no) <i>Alcohol use</i> : In the last year, how often did you have alcohol to drink? Responses ranged from (1) less than once a month to (6) every day. <i>Marijuana use</i> : On how many occasions have you used marijuana in the past 30 days? Responses ranged from (0) never to (6) 40 or more times.	There were no significant relationships between participation in organized sports during adolescence and alcohol and marijuana use 12-years later.
Sport participation and problem alcohol use: a multi-wave national sample of adolescents Mays et al. (2010)	N = 8721 (56% female); a representative sample of adolescents (aged 12-to-18 at baseline), and two follow-ups 3-years apart.	<i>Sport participation</i> : A count of sports participated at baseline (e.g., cheerleading/dance, baseball/softball, hockey, basketball, football, soccer, swimming, tennis, track, volleyball, wrestling, and other sports). <i>Alcohol use</i> : A count variable that was created for each wave by summing up dichotomous responses to frequency in the past 12 months; binge drinking; and alcohol-related problems (e.g., doing something regrettable while drinking).	Participation in sports alone was a significant predictor of growth in alcohol-related behaviors over the 6-years. Participation in sports with participation in other school activities showed significantly less accelerations in alcohol-related behaviors compared to sport participation alone.
Jocks, gender, race, and adolescent problem drinking Miller et al. (2003)	N = 611 (61% female); a probabilistic sample of Western New York adolescents (aged 14 at baseline), and they were followed-up 6 years later.	<i>Sport participation</i> : Baseline measure of frequency of sports in the past year: Responses ranged from (0) none to (5) 3 or more times per week. <i>Alcohol use</i> : A count variable inclusive of frequency in drinking, the average consumption, and frequency in binge drinking.	The frequency of sport participation was not related to frequency of drinking and binge drinking.
Adolescent pathways to adulthood drinking: Sport activity involvement is not necessarily risky or protective Peck et al. (2008)	N = 1000 (60% female); convenience sample of young adolescents in Michigan beginning at the age of 12 and included 3 follow-ups 4-years apart.	<i>Sport participation</i> : A count measure of sport participation asking: In the last 6 months, how many hours did you spend each week taking part in organized sports (1) less than 15 min to (4) 1 h or more per day. <i>Alcohol use</i> : How often in the past 6 months did you drink alcohol? & How often in the past 6 months have you gotten drunk? Responses ranged from (1) never to (7) 21 or more).	There was a positive relationship between adolescent sport activity and heavy drinking at age 28. The positive relationship was stronger among sport participants who were also above average users of alcohol and drugs at age 18.

Table 2 (continued)

Study	Sample	Measures used	Primary findings
Substance use and exercise participation among young adults: parallel trajectories in a national cohort-sequential study Terry-McElrath and O'Malley (2011)	N = 11,741; a subsample of a representative group of high school graduates (approximately age 18 at baseline), and they were re-assessed 4 times every 2 years.	<i>Sport participation</i> : A baseline measure of team sport participation was measured by asking: "To what extent have you participated in athletic teams during the school year?" Responses ranged from (1) not at all to (5) great. <i>Alcohol & marijuana use</i> : How many times in the past 30 days have you used alcohol? How many times in the past 30 days have you used marijuana? Responses ranged from (1) no occasions to (7) 40+ occasions. <i>Illicit drug use</i> : Use of illicit drugs other than marijuana (e.g., LSD, cocaine, hallucinogens, amphetamines, heroin, and barbiturates). Responses were dichotomized into yes/no.	Sport participation was significantly associated with increased alcohol use at the age of 18. Sport participation was significantly associated with lower marijuana and other illicit drug use at the age of 18. Sport participation was not significantly related to changes to changes in alcohol, marijuana, or other illicit drug use over time.
Does sport participation during adolescence prevent later alcohol, tobacco, and cannabis use? Wichstrom and Wichstrom (2009)	N = 3251; nationally- representative sample of high school students in Norway (aged 13-to-19 at baseline), and they were re-assessed 2, 5, and 7 years later.	<i>Sport participation</i> : The respondents were asked about whether they had competed in or were currently competing in any sports, and the type of sport(s). The sport they were involved in most was used in the present analyses <i>Alcohol use</i> : There were two questions related to alcohol use in the previous 12 months: 1) how often were you drunk so much that you felt clearly intoxicated; and 2) the number of binge drinking episodes (5+ alcohol units of 5 cl alcohol at one sitting). Responses were on a six-point scale ranging from (0) none to (5) more than 50 times. <i>Marijuana use</i> : How often did you use cannabis during the preceding 12 months? Responses were on a six-point scale ranging from (0) none to (5) more than 50 times.	Sport participation predicted growth in alcohol intoxication and cannabis use. In the comparison between type of sports and substance use, endurance sports had a lower growth in alcohol, whereas initial team sports had an increased growth in alcohol intoxication but reduced growth in cannabis use.

participation may indeed be a risk factor for alcohol use throughout adolescence and into early adulthood, it appears that sport participation may be a protective factor for illicit drug use, although the literature on cannabis use is less clear.

4.1. Alcohol use

Collectively, our results suggest that sport participation is positively associated with greater alcohol use during adolescence and into early adulthood. Regardless of whether the longitudinal studies were short- or long-term studies, the findings were generally consistent with previous systematic reviews (Diehl et al., 2012; Lisha & Sussman, 2010; Mays et al., 2011). More than 80% of the studies found a positive relationship between sport participation and alcohol use; and most importantly, we did not find any longitudinal studies that showed a protective effect of sport participation on alcohol use. Several cross-sectional studies have found a negative relationship between sport participation and alcohol use (e.g., Donato et al., 1994; Elder, Leaver-Dunn, Wang, Nagy, & Green, 2000; Thorlindsson & Bemburg, 2006), but our findings clearly show that sport participation was related to increases in alcohol use.

Importantly, 76% of the studies found increases in alcohol use from baseline to subsequent follow-ups – six of which included three or more assessments of alcohol use. These findings are consistent with epidemiological data showing significant increases in binge drinking during emerging adulthood (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). Our findings suggest that sport participation during the adolescent period corresponds to greater alcohol use in late adolescence and early adulthood. Despite the longitudinal designs, however, none of the studies considered changing patterns of sport participation with changing patterns of alcohol use. To better inform how sport participation impacts immediate and long-term alcohol use, future work must consider how changes in sport participation correspond with changing alcohol use over time.

Sports can also vary in terms of being individual, partner and team sports; contact and non-contact sports; or their emphasis on strategy, chance and physical skills. Consequently, sport is not a homogenous, standardized product, or experience (Coalter, 2005). Previous research has indicated that the relationship between sport participation and alcohol use may depend on the type of sport (e.g., Ford, 2007). Unfortunately, we were only able to locate one longitudinal study that examined the effect of sport type. Indeed, Wichstrom and Wichstrom (2009) found differences in alcohol use based on the type of sports individuals participate in; that is, team sport participants had greater increases in alcohol use compared to individual-based sport participants. Furthermore, it appears that participants in technical sports are also at greater risk for alcohol use compared to athletes in endurance sports. Technical sports were defined as sport activities that were neither a power sport (e.g., lifting, wrestling) nor an endurance sport (e.g., running, cycling). This sport classification is problematic. In addition to the broad categorization of technical sports, it is conceivable that individual athletes participating in an acrobatic sport like gymnastics were categorized the same as athletes participating in a team sport such as soccer. Clearly, more work is needed to determine how different types of sports relate to increased alcohol use, and also how these sport types interact with one another. Future longitudinal studies may also want to consider how different performance levels (e.g., recreational versus elite) influences the association between participation and alcohol use. This is an area that appears to be underexplored, and is important for the design of future interventions that may need to be tailored to different levels of performance.

4.2. Illicit drug use

The evidence regarding the effects of sport participation on illicit drug use was somewhat less clear compared to alcohol use. Overall, there were 11 studies included in our review that examined the use of marijuana and other illicit drugs. A lack of standardized measures (see

below), however, may have complicated our findings. For example, in some studies, we could isolate the independent effect of sport participation on cannabis use, while other studies had an “any” drug use approach, which included the use of marijuana. In the studies that examined marijuana use independent of other drugs, half of the studies showed a protective effect, while the other half reported no effect at all. Interestingly, the studies finding a positive effect for sport participation were focused largely on marijuana use during high school (Barber et al., 2001; Darling, 2005; Dawkins et al., 2006), while the studies that found no relationships tended to assess cannabis use after individuals transitioned into early adulthood (Mahoney & Vest, 2012; Wichstrom & Wichstrom, 2009). This was also true for other illicit drugs, as several studies suggested that the inverse relationship between sport participation and overall drug use was stronger during late adolescence (Barber et al., 2001; Peck et al., 2008; Terry-McElrath & O'Malley, 2011). The reasons for these findings are not entirely clear but it may be related to methodology. It may be that studies that follow participants into early adulthood often include long gaps between assessments (e.g., sport participation is assessed at age 10 with a follow-up evaluation on drug use a decade or more later); therefore, it may be difficult to assess the role of sport participation without understanding what is happening in between follow-up points.

Another explanation may be related to the ‘leveling’ or ‘maturing out’ hypothesis based on overall changes in drug use with age. Terry-McElrath and O'Malley (2011) provide some evidence of this, as cannabis use appears to decrease during late adolescence and into early adulthood. Specifically, they found fewer sport participants engaging in marijuana use, but only after they had reached the ages of 21 or 22. The failure to find a positive effect of sport participation on marijuana use once they have reached adulthood may simply be due to overall declines in use corresponding with age. While it is intriguing that our results show a positive effect of sport participation during the transition from late adolescence into early adulthood, future longitudinal studies with more rigorous designs are required. For example, long-term cohort studies that span the transition from adolescence into early adulthood (with annual or biannual assessments of both sport participation and substance use) would enable us to test the maturing out hypothesis, while at the same time addressing other limitations (e.g., long gaps between assessments).

When we focus on studies assessing other drug use beyond the exclusive focus on cannabis, the results are more encouraging. Most of these studies found sport participation being associated with lower overall use of illicit drugs; and while we have several measurement concerns, it does appear that sport participation during this period of development offers some protective effect against the use of illicit drugs. Similar to alcohol use, however, future research must examine how sport participation over time impacts drug use during the emerging adulthood period.

4.3. Limitations within the current literature

Existing longitudinal studies continue to suffer from many of the methodological weaknesses and limitations previously identified in previous reviews (Diehl et al., 2012; Lisha & Sussman, 2010; Mays et al., 2011) and commentaries concerning this area of inquiry (Mays et al., 2011). First, all of the studies in our review rely on self-report data (both in relation to sport participation and in relation to reported use of alcohol and illicit drugs). While self-report may be a reasonable measurement approach for assessing sport participation, its use for alcohol and illicit drug use behaviors in adolescents is not without limitations. Specifically, bias in reporting, either under or over-reporting, cannot be established and concerns over issues related to social desirability reduces our confidence in the accuracy, and therefore, overall quality of these data. The considerable heterogeneity that exists across these studies in terms of how alcohol and illicit drug use are measured represents another level of concern. As noted above, No standardized measures (e.g., AUDIT, YAACQ) of alcohol and drug use were used,

though some studies included composite measures of overall substance and drug use. This measurement heterogeneity makes comparisons very difficult. Future work with self-report measures with known reliability and validity for assessing alcohol use and drug use is necessary. In assessing illicit drug use, studies should also differentiate between drugs such as marijuana, cannabis, and other illicit drugs such as cocaine.

Beyond the use of self-reporting, the ways in which responses to sport participation questions are scaled in these studies also raises many methodological concerns. The studies in our review treat sport participation as either an all or nothing (yes/no) proposition or as a gross “count” of participation measured at one point in time. Such an approach renders it impossible to ascertain whether certain types of sports may be more or less risky or protective in relation to substance/alcohol use. As discussed previously, this is problematic because there is some evidence that the use of alcohol and drugs may vary by sport type (Ewing, 1998; Ford, 2007; Wichstrom & Wichstrom, 2009). We are also concerned that sport participation and physical activity are usually not included in the same study or analyses (i.e., they are treated as separate measures). Therefore, it is unclear whether all or part of the effect of sport participation is due to physical activity or if there are other effects of participation that are important beyond physical activity per se. This in fact relates to a broader concern about what exactly sport participation is capturing in these studies.

4.4. Future directions

Given the robustness of the association between sport participation and increased use of alcohol, it is imperative that we better understand the reasons why sport participants appear at greater risk when compared to adolescents and young adults who do not engage in a sport, particularly during the peri-adolescent period. None of the studies in our review analyzed psychosocial and/or behavioral pathways (mediating or moderating effects) that might explain how sport might be protective of alcohol and illicit drug use among youth. Some studies did examine the potential effect of socio-demographic factors such as gender, race, and socio-economic status, as moderating factors affecting the association between sport participation and alcohol use (Aaron et al., 1995; Crossnoe, 2002; Eccles & Barber, 1999; Eitle et al., 2003; Hoffmann, 2006); however, until we understand the potentially modifiable risk factors at both the individual and social levels, we are unlikely to be able to design effective interventions to address these problems. In the interim, it is clearly important that public awareness campaigns, coupled with educational programs, should be developed targeting specific stakeholder groups involved in youth sports (e.g., parents, coaches, national and provincial sporting organizations). Similarly, while the evidence linking sport participation to decreased use of illicit drugs is encouraging, particularly during the high school period, studies have not yet identified psychological, behavioral, and social factors that might explain why sport is protective in this context. Theoretically informed, analytic studies exploring mechanism are clearly needed.

The lack of longitudinal data from outside the United States is striking, and we would caution the extrapolation of the results of the studies in this review to the broader global context. More work from other countries is required to test the robustness of the effect for sport participation on alcohol and drug use. There may be existing datasets, however, that can address this issue. For example, Canada has the National Longitudinal Survey of Child and Youth, a nationally representative survey that includes measures of both sport participation (i.e., organized activities that include some team and individual sports) and drug and alcohol use, repeatedly assessed on the same subjects. To our knowledge, however, these data have not yet been used to explore the effect of sport participation on alcohol and drug use during emerging adulthood.

Another notable gap in the literature concerns the lack of intervention-based studies. While our initial search parameters were set to include intervention-based studies, only two were found to

even warrant further review. First, a study by Werch et al. (2003) developed what was called a sport-based intervention. Upon further review, however, the intervention is perhaps better described as an educational intervention (on healthy active living) delivered by a nurse. Second, Kristjansson, James, Allegrante, Sigfusdottir, and Helgason (2010) ran a national program aimed at engaging an entire community in Iceland (e.g., leaders, schools, individuals), with one aim of increasing participation in sport activities. While the study was an example of an ecological intervention encouraging sport participation, the design is limited because the intervention efficacy, let alone fidelity, was not directly assessed. Clearly, more research using sport as a form of intervention towards alcohol and/or drug use prevention is necessary.

One final issue concerns the way that outcomes are selected in studies such as this and other reviews. As both Diehl et al. (2012) and Mays et al. (2010) have noted, most studies tend to focus on discrete health behaviors (e.g., smoking, alcohol use, and drug use), and therefore fail to consider a broader range of both risky and health protective behaviors that may be associated with sport participation. While this is understandable, it is difficult to assess the impact that sport participation has on health when researchers fail to sample the universe of potential health effects related to participation. Indeed, we run the risk of either over- or under-estimating the health impacts of sport if we do not consider the full range of potential outcomes. This also raises interpretive problems that are associated with making judgments about risk and protective trade-offs. If sport participation is indeed linked to an increased use of alcohol, is alcohol use an acceptable risk if it also means a reduced risk of illicit drug use? In this review (and in others), we excluded studies that examined the use of performance enhancing drugs (PEDs). If sport, especially elite sport, encourages use of PEDs, can we really say that is an acceptable trade-off if adolescents who participate are also less likely to use illicit drugs and/or tobacco?

There is no doubting the appeal of sport to many youth — this can be used to attract youth particularly those who might be at risk of illicit drug abuse. However, sport participation needs to be embedded in wider programs of personal and social development with programs structured to provide access to a range of factors that may protect against alcohol and/or drug abuse (Witt & Crompton, 1997). Sport itself may not be the solution to preventing alcohol/substance abuse, but as a component of wider initiatives, it could be a part of the solution (Faulkner et al., 2007).

4.5. Conclusion

Sport, like many other activities, is not a priori good or bad, but it has the potential to produce both positive and negative outcomes. For example, despite ‘common sense’ assumptions that sport promotes moral development, research is relatively consistent that participation in team sports actually promotes a less mature form of moral reasoning (Bredemeier & Shields, 2006). The results of our review also support this general observation. Risk effects of sport participation in relation to alcohol use may be related to peer-group interaction and/or a culture of drinking that is associated with many sports — after all, alcohol consumption is a socially acceptable form of celebration and in sport there may be many opportunities for celebration or commiseration. The more critical question to ask is what ‘conditions are necessary for sport participation to have beneficial outcomes’ (Coalter, 2005) in terms of preventing alcohol or illicit drug use? This question has not been asked in the existing literature and should be central to future research and practice efforts in this area.

Role of funding sources

This study was supported by the Canadian Centre for Substance Abuse.

Contributors

MYK, GEF, PD, and JC contributed to the conception of the study and made significant contribution to the final paper. MYK, SB, and JC conducted the data analysis, and completed the initial draft of the paper. All authors have read and approved the final manuscript.

Conflict of interest

All authors decline that there were no conflicts of interest.

Acknowledgments

Dr. Kwan was a Lawson Postdoctoral Fellow supported by the Offord Centre for Child Studies at McMaster University. Dr. Cairney is supported through and endowed professorship through the Department of Family Medicine at McMaster University.

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