Substance use in university sport: A cross-national study of student-athlete substance use behaviors and perceived responses to witnessing substance use.

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Abstract

Objectives: Substance use among university student-athlete populations is a growing concern but research addressing this issue is primarily confined to the US. Also, the exposure of witnessing other student-athletes using substances and how student-athletes may respond when witnessing other athletes taking substances across countries and gender is unknown. This research aimed to address these issues. **Design:** A cross-sectional design was employed. **Method:** Student-athletes from the US (N=208), UK (N=201) and Canada (N=159) completed measures of reported substance use, witnessing substance use, and (anticipated)

responses to addressing peers' substance use. **Results:** Chi-square and logistic regression analyses revealed that country and gender were associated with various outcomes. Key findings include that differences in substance use as a function of country was largely substance-specific, and a higher proportion of men than women reported using most supplements apart from vitamins and minerals, and dietary based supplements. A higher proportion of athletes in Canada and USA reported they would "confront the individual" if they witnessed a peer taking dietary supplements, prescription medication and banned appearance and performance enhancing substances than in UK. Also, a higher proportion of women than men reported they would "report to someone else" (e.g., coach, sport governing body) if they witnessed peers taking substances. **Conclusion:** Although a convenience sample from nine universities across the three countries participated in this research, our findings provide initial evidence for the role of gender and country in relation to athletes' substance use behaviors and anticipated responses to addressing substance use. These findings underline the importance of conducting context-specific and cross-national research to help facilitate tailored substance use education for student-athletes.

Key Words: cross-cultural comparison, gender differences, doping, NCAA

1.1 Introduction

The use of drugs and alcohol are a common problem on university campuses and student-athletes are assumed to consume both at higher rates in comparison to their non-athlete peers (e.g., Yusko, Buckman, White, & Pandina, 2008; Brisola-Santos et al., 2016; Ford, 2007). Substance use is risky for both students and student-athletes; however, the stakes are arguably higher for student-athletes as drug use not only presents potential health risks, but can also jeopardize their athletic eligibility since some drugs consumed regularly and legally by non-athletes (e.g., marijuana) actually constitute doping (in the context of this paper, doping refers to the use of prohibited substances and methods) for student-athletes. In

relation, the World Anti-Doping Agency (WADA) is the global governing body tasked with leading a collaborative worldwide movement for doping-free sport. To support this, the WADA enforces The Code (WADC; WADA, 2015) – a global rulebook outlining what is considered an anti-doping rule violation (ADRV). This is supplemented by the Prohibited List (WADA, 2018), delineating which substances and methods are banned in sport and under what conditions (e.g., in-competition/out-of-competition, particular sports). Not all sporting organizations adhere to the WADA Code though, and university sport is a competitive level where this distinction is particularly pertinent.

The National Collegiate Athletic Association (NCAA) is the governing body for university sport in the US and it is *not* WADA-compliant. In contrast, USport (Canadian university sport governing body) and British Universities and Colleges Sport (BUCS; UK university sport governing body) *are* WADA-compliant. The differing WADA-compliance statuses have limited impact in relation to what substances and methods are prohibited, but they significantly influence the consequences of doping. Exemplifying this, the standard sanction for an NCAA student-athlete who tests positive (first offense) for the intentional use of an anabolic steroid is one year. Meanwhile, that same student-athlete would be liable to a four-year sanction in the UK or Canada. The potentially substantial personal and athletic consequences facing student-athletes who consume substances prohibited in sport at the collegiate level underlines the importance of determining and monitoring drug use trends among this population and across national borders. However, literature on student-athlete drug use is scarce (Druckman, Gilli, Klar, & Robison, 2015; Yusko et al., 2008) and largely confined to the NCAA context.

1.1.1 Doping prevalence

Determining accurate substance use prevalence rates is critical for facilitating the evaluation and effectiveness of anti-doping efforts and policies (de Hon, Kuipers, & van

Bottenburg, 2015), yet evidence is limited across all competitive levels, not just the collegiate context (Erickson & Backhouse, 2018). Considering elite sport, the prevalence of doping is argued to be between 14 - 39%, but this figure can differ widely across various sub-groups (e.g., sport, national, training group) of athletes (de Hon et al., 2015) and cross-cultural differences in prevalence rates have been identified using the randomized response technique (RRT). Specifically, prevalence rates among 448 (66.1% M) elite German athletes were estimated to range from 25.8 - 48.1% lifetime use (Pitsch, Emrich, & Klein, 2007). In comparison, lifetime doping rates among Dutch elite athletes were reported at 4.2% (Duiven & de Hon, 2015) and within a sample of 771 Danish elite athletes (56.5% M), between 3.1 – 26% reported lifetime doping use (Elba & Pitsch, 2018). Despite an indication that doping prevalence rates may differ across national borders, research is yet to explore potential cross-national differences within the same study.

1.1.2 Student-athlete drug use

The only large scale student-athlete substance use survey in existence globally is the NCAA Substance Use Survey that is launched every four years across all three athletic divisions. The most recent version was hosted during the 2017 academic year and was completed by approximately 23,000 NCAA student-athletes. The findings revealed the following self-reported drug use rates in the past year (gender breakdown is specified where possible): 24.7% used marijuana (Male: 26.3%, Female: 22.3%), 0.2% used methamphetamines (Male: 0.3%, Female: 0.1%), 0.4% used anabolic steroids, 0.1% used erythropoietin (EPO), 0.3% used human growth hormone (HGH), and 3.8% used cocaine (Male: 5.2%, Female: 1.7%) (Cook, Radford, & Durham, 2018). Gender has been identified as an important consideration in student-athlete substance use research (Grossbard, Hummer, LaBrie, Pederson, & Neighbors, 2009) and where gender breakdown was provided in the 2017 NCAA study (Cook et al., 2018), males reported greater use of each substance in

comparison to females. This is consistent with the broader anti-doping literature (e.g., Backhouse, Whitaker, Patterson, Erickson, & McKenna, 2016; Ntoumanis, Ng, Barkoukis, & Backhouse, 2014) where male athletes generally report more frequent use of substances and a more positive attitude towards doping than their female counterparts. Differing body image ideals for men and women in Western cultures whereby women report a greater drive for thinness (e.g., Levitt, 2004; Striegel-Moore et al., 2009), and men report a greater desire to increase muscle mass in the pursuit of muscularity (e.g., Grossbard, Lee, Neighbors, & Larimer, 2009; Bratland & Sundgot, 2012) may explain these consistent differences. Yet, gender differences in student-athlete substance use behaviors are largely unknown due to the dearth of existing literature. It is therefore important to explore potential gender differences in student-athlete substance use behaviors.

The NCAA is one of many university sport governing bodies worldwide so it should not be assumed that NCAA-specific drug use trends are generalizable to broader student-athlete drug use behaviors (e.g., in the UK or Canada). This is especially true because sport is more integrated into the education system in the US and is well-funded and organized at the university level (Zhou & Heim, 2014). In contrast, university sport in other countries is relatively low profile (Houlihan, 1997) which has potential implications for student-athlete substance use behaviors. For example, the financial and opportunity value of athletic scholarships in the US may influence student-athletes' attitudes and behaviors towards substance use. The desire to obtain and maintain sport sponsorships has been identified as a potential facilitator of doping behavior (e.g., Kegelaers, Wylleman, De Brandt, Van Rossem, & Rosier, 2018), and doping willingness (e.g., Whitaker, Long, Petróczi, & Backhouse, 2014), and athletic scholarships are increasingly desirable within the NCAA context. Rising tuition costs in US universities have heightened the competition to earn athletic scholarships (Avallone, 2018) but the reality is only 2% of US high school athletes will be awarded some

degree (i.e., partial or full) of Division I athletic scholarship (NCAA, 2018). Even then, the scholarship is not guaranteed and, in most cases, it can be revoked at any point during an athlete's collegiate career. Conversely, athletic scholarships feature less frequently in the UK and Canadian collegiate contexts; which may minimize the risk of this being a facilitator of doping behavior within those particular contexts. The structural differences in collegiate sport across national borders further underlines the importance of cross-cultural comparisons in substance use.

Differing drug laws across the cultural contexts may also influence student-athletes' self-reported substance use behaviors. At the time of data collection, recreational marijuana use was legal across multiple US states but not legal in the UK or Canada. Meanwhile, the substance remains banned in sport across all three contexts. The social norms surrounding marijuana may influence student-athletes' attitudes and approaches towards the drug. Social norms theory (Berkowitz, 2005) suggests that norms (socially constructed expectations of appropriate behavior) impact health behaviors, including substance use (Egan, Erausquin, Milroy, & Wyrick, 2016; Perkins & Berkowitz, 1986), and specifically among student-athlete populations. For example, social norms have been demonstrated to influence student-athletes' behaviors in relation to: synthetic cannabinoid use (e.g., Egan et al., 2016), alcohol consumption (e.g., Hummer, LaBrie, & Lac, 2009) and marijuana use (LaBrie, Grossbard, & Hummer, 2009). It is therefore feasible that social norms may influence student-athletes' self-reported substance use behaviors, the frequency with which they witness the use of particular substance and/or how they anticipate addressing particular substance use behaviors exhibited by peers.

Limited attention has been afforded towards understanding athletes' views towards addressing the witnessed substance use of others. Preliminary research with US and UK student-athletes demonstrated that student-athletes were hesitant to report (i.e., whistleblow)

doping (dietary supplements, prescription medications, appearance and performance enhancing drugs, recreational drugs) despite being personally opposed to banned substance use (Erickson, Backhouse, & Carless, 2017). Specifically, Erickson et al. (2017) found that athletes' reluctance to whistleblow was largely underpinned by relational concerns, and reflected a true moral dilemma between reporting the athlete who doped to protect the integrity of sport, or to keep quiet to protect the reputation and well-being of the athlete who doped. Moreover, some student-athletes suggested that there were potentially two additional options for addressing peers' doping behaviors; to report it to 'someone' else (e.g., a coach) or to confront the athlete who doped directly. Thus, multiple options for addressing doping in sport (ignore, whistleblow, confront, report to someone) were identified in the research. Research examining the prevalence of how athletes perceive they would respond to witnessing other athletes taking substances therefore warrants investigation.

1.2 Purpose of this research

To date, no research has examined (potential) cross-national and gender differences in student-athletes' substance use behaviors, frequency of witnessing others taking substances in their social networks, or how athletes anticipate addressing others' substance use. Therefore, the objectives of this study were to explore (1) whether country and gender were associated with reported student-athlete substance use, (2) whether country and gender were associated with the frequency at which student-athletes witnessed peers using specific substances and (3) whether country and gender were associated with student-athletes' anticipated approach to addressing substance use by peers. Given the exploratory nature of this research, we were not in a position to hypothesize about whether or not country was associated with any of our outcome variables, nor were we able to make predictions about if gender was associated with frequency of witnessing substance use or how student-athletes would address the issue. However, since research consistently indicates that men consume substances at a greater rate

than women (Backhouse et al., 2016), we expected that men would report higher substance use rates compared to women.

2.1 Method

2.1.1 Participants

Convenience sampling was employed to recruit NCAA, USport and BUCS university student-athletes. Student-athlete gatekeepers were extended an invitation for student-athletes to participate through personal invitations (email, phone call) from members of the research team. Forty-eight universities across the three countries were invited to participate and nine universities accepted the invitation [US=4 (DI=1, DII=3); Canada=2; UK=3]. A total of 568 student-athletes across the three countries participated. A similar number of males and females participated in the study (53% and 47%). The slight majority were drawn from the US (n = 208, male = 41%, female = 59%), then the UK (n = 201, male = 61%, female = 39%) and Canada (n = 159, male = 57%, female = 42%). Across the three countries, student-athletes were in first (29%), second (25%), third (27%), fourth (14%), fifth (2%) year of their university studies, or postgraduate students (4%) at the time of data collection. Participants competed in a total of 40 different sports (both team and individual) with the most common sports being cross country/track and field (16%); American football (12%); soccer, field hockey, rugby (11% each); basketball (7%); softball, lacrosse (4% each).

2.2 Measures

2.2.1 Reported substance use.

To measure self-reported substance use, we asked participants how often in the last 3 months they had taken any of 11 types of substances, or any products that contained these substances. The list of substances included six supplements (e.g., “creatine”, “protein supplements [e.g., whey protein]”, “caffeine and caffeinated supplements for sport performance, excluding regular coffee consumption”), three banned appearance and

performance enhancing drugs (APEDs; e.g., "growth hormone or IGF-1", "Erythropoietin (EPO)"), and two recreational drug categories (e.g., "cannabis [e.g., marijuana, weed etc.]", "cocaine, heroin, methamphetamines [including crystal meth, ice, etc.])". A full list of the substances is presented in Tables 1 and 2. Participants indicated the frequency they had taken each substance by circling one of the following options: "*never*", "*once a month*", "*once a week*", "*more than once a week*" or "*don't know*". We combined "*once a week*" and "*more than once a week*" to one variable "*at least once a week*" for analysis purposes.

2.2.2. Witnessing substance use.

To measure the frequency participants had witnessed another athlete taking substances, participants responded to four-items in relation to the stem, "While at university, have you witnessed any of the following situations…". The four items were, "an athlete using a dietary supplement that has not been certified by a third party (e.g., Informed Sport/Choice), "an athlete using a prescription medication (e.g., Adderall) without a personal prescription", "an athlete using banned appearance and performance enhancing drugs (e.g., anabolic steroids), and "an athlete using recreational drugs (e.g., cannabis)". Participants responded to each item by circling one of the following options: "*never",* "*once*", "*a few times within the past year*", "*within the last month*", and "*within the last week*". For analysis purposes, as participants reporting "*once*" could have also witnessed this within particular timeframes on other options, we decided to collapse responses as "never" or "at least once" for analysis purposes.

2.2.3. Anticipated response to addressing substance use.

To measure how athletes would respond to other student-athletes taking specific substances, participants were asked to consider the same items as those used to measure the frequency of witnessing substance use (i.e., dietary supplements; prescription medication; banned APEDs; and, recreational drugs) after reading the stem "How would you respond to a

student-athlete at your university using….". Participants responded to each item by circling one of the following responses: "*do nothing*", "*report to authorities (e.g., report doping hotline)*", "*report to someone (e.g., coach)*", "*confront the individual*", or "*join in*". These responses were drawn from previous qualitative research indicating how student-athletes anticipate responding to others engaging in substance use (Erickson et al., 2017).

2.3 Procedures and data collection

Following approval from the research team's university ethics committee, participants were recruited via the support of relevant gatekeepers (e.g., coaches) to arrange a convenient time to invite their athletes to take part. Data was collected in person during the 2016 – 2017 academic year. Participants were introduced to the project by a member of the research team and provided with an information sheet which reinforced the study purpose, the voluntary nature of participation, that questionnaires were completed anonymously and kept confidential, and their right to withdraw from the study. After filling in a consent form, participants then completed the substance use survey which included the measures described above (this took approximately 15 minutes). Once completed, the participants handed the questionnaire directly back to the researcher and were thanked for their participation.

2.4 Data Analyses

Due to the categorical nature of the variables, we calculated the frequency of responses, and initially conducted Pearson Chi-Square tests to examine whether country and gender were related with these variables (i.e., reported frequency of substance use, frequency of witnessing substance use). Prior to these analyses we also checked for missing values, and when athletes reported multiple responses (where asked to report one response) or a response had an expected count less than 5, we removed such cases from the Chi-Square analyses. We then conducted a series of follow-up multinomial or binomial logistic regressions including country and gender predictor variables to specifically examine where associations were

found. As country comprised of 3 groups, we dummy coded each country prior to inclusion in analyses. To help control for a potential confounding effect for time at university and partially age, we controlled for year at university in these analyses. Moreover, given that team norms could shape athletes' behaviors (Graupensperger, Benson, & Evans, 2018) and since previous research (Partington et al., 2013) has found differences in reported drinking rates between team versus individual sport athletes, we also controlled for type of sport (team vs individual sports) in the logistic regression analyses. Due to the numerous analyses and to help control for Type I error, we report significance at $p \leq .01$. However, to aid interpretation for the reader we also indicate in Tables where $p \leq .05$, with any associations with p values between $p \leq .05$ to $> .01$ considered marginal in the present study.

3.1 Results

3.1.1 Reported substance use

The first aim of this study was to examine whether country and gender were associated with reported frequency of substance use in student-athletes. We removed responses for "don't know" from the Chi-Square analyses due to the small proportion of responses for this option and it not being reflective of frequency of substance use. Chi-Square analyses were not conducted for herbal supplements to increase testosterone (98% reported never), Growth hormone (99% reported never), EPO (97% reported never), anabolic steroids (99% reported never), and cocaine, heroin or methamphetamine (95% reported never) due to a vast majority of participants reporting they have "never" used these substances in the last 3 months (>95%), and thereby expected counts for other options were below 5. The frequency of reported use of remaining substances across countries as well as Chi-Square analyses are presented in Tables 1 and 2. Chi-Square analyses revealed that country and gender were significantly associated with the use of each type of substance, apart from cannabis whereby both country ($p = .02$) and gender ($p = .03$) were marginally associated.

We then conducted a series of follow-up logistic regressions to examine how country and gender were associated with substance use which are reported in Table 3. Multinomial regressions were conducted for protein as well as vitamin and mineral supplementation. However, due to the limited number of users (i.e., mostly >30%) for the other substances, we collapsed "*monthly*" and "*weekly*" so only two categories remained (i.e., non-users and users). The multinomial regression for protein supplementation revealed that neither country nor gender were associated with monthly use. However, for weekly use gender was negatively linked with protein use which indicated that men reported higher use of protein supplements than women. In terms of country, a marginal association was noted (p = .03) for the comparison between USA and Canada whereby student-athletes in Canada reported more frequent weekly use of protein than counterparts in USA.

For vitamin and mineral supplementation, gender was positively associated with monthly use, and marginally with weekly use (p =.02), suggesting women reported more frequent use of vitamin and mineral supplement use. However, no associations were found for country in terms of monthly use, but a significant association was noted for the comparison between USA and UK suggesting that student-athletes in USA reported more frequent weekly use of vitamins and minerals than UK student-athletes. A marginal association was also noted (p = .02) for the comparison between Canada and UK, whereby student-athletes in Canada reported marginally more frequent weekly use than in UK.

Gender was negatively associated with creatine use, which suggested more men reported using creatine supplements than women. Moreover, associations were noted for comparisons between USA and UK, and USA and Canada, suggesting that more student-athletes in Canada and UK reported using creatine than in USA. Also, a marginal association (p = .04) suggested a marginally higher proportion of student-athletes in UK reported using creatine than in Canada. For caffeine supplementation, a negative association for gender

indicated a higher proportion of men reported using caffeine than women. Also, an association between Canada and UK revealed that more student-athletes in UK reported using caffeine than in Canada, and a marginal link (p = .03) suggested student-athletes in UK reported higher caffeine supplementation use than in USA.

Logistic regression revealed gender differences, and comparisons between both Canada and USA with UK student-athletes associated with weight loss supplements. Specifically, a higher proportion of women used such supplements then men, and a higher proportion of student-athletes in UK reported using such supplements than their counterparts in Canada and USA, but no associations were noted for the comparison between Canada and USA. For cannabis use, the comparison between Canada and UK student-athletes was associated with cannabis use, whereby a higher proportion of student-athletes in Canada reported using cannabis than in UK. Marginal links were also noted for gender (p = .02) and, for the comparison between USA and UK (p = .011) student-athletes, suggested marginally more men than women, and more student-athletes in USA than UK used cannabis.

3.1.2 Witnessed substance use.

The frequency that athletes witnessed substance use across countries, along with Chi-Square analyses are presented in Table 4. On the whole, the highest proportion of athletes reported they “never” witnessed other student-athletes taking dietary supplements, prescription medication, and banned APEDs. Recreational drugs however were more frequently witnessed. Specifically, Chi-Square analyses revealed that country was associated with reported frequency of witnessed use of prescription medications, banned APEDs and recreational drugs, but not dietary supplements. Gender was associated with dietary supplementation and using banned APEDs. Follow-up binomial regressions are reported in Table 5. Specifically, these analyses revealed that only gender was associated with dietary supplement use, which suggested a higher proportion of men than women witnessed other

student-athletes taking dietary supplements. Moreover, only comparisons between both Canada and USA with UK revealed significant associations with prescription medication whereby more student-athletes in Canada and USA reported witnessing other student-athletes taking such substances than their counterparts in the UK. Gender was negatively associated with witnessed banned APED usage, whereby a higher proportion of men than women reported witnessing such use. Moreover, a significant association for the comparison between UK and USA, and a marginal association (p = .04) between Canada and USA for banned APEDs suggested that a marginally higher proportion of student-athletes in UK and Canada reported witnessed other student-athletes taking banned APEDs than their counterparts in USA. In terms of witnessing recreational drugs, gender was not associated with witnessing such substances, however the comparison between Canada and UK athletes was significant whereby a higher proportion of student-athletes in Canada reported witnessing recreational drugs use than in UK. Taken together, there is evidence that country and to an extent gender were associated with frequency that student-athletes witnessed substance use by peers.

3.1.3 Anticipated responses to addressing substance use.

Our final aim was to explore whether country and gender were associated with athletes' anticipated responses to addressing substance use. Due to student-athletes reporting that they would very rarely "join in" with other athletes taking dietary supplements, prescription medication and banned APEDs, these responses were excluded from analyses. Also, as a low proportion of student-athletes said they would report the athlete "to authorities" for taking these substances (all <4%), we combined these responses with reporting "to someone else" in these analyses.

Pearson's Chi-Square revealed a significant association between country and how athletes anticipated addressing each type of substance use by peers (see Table 6) as well as between gender and anticipated responses to others' using each type of substances albeit

marginally with dietary supplementation (p = .02). Follow-up multinomial regressions revealed that country was not associated with *reporting to someone else* for dietary supplementation nor prescription medication, but gender was associated with *reporting to someone else* for prescription medication and marginally for dietary supplementation (p = .011) whereby a higher proportion of women than men reported they would *report to someone else*. Comparisons between Canada and USA student-athletes with counterparts in UK were associated with responses pertaining to *confronting the individual* in relation to both dietary supplementation and prescription medication. Specifically, a higher proportion of student-athletes in Canada and USA anticipated they would *confront an individual* taking both types of substances compared to counterparts in UK.

In terms of banned APEDs and recreational drug use, gender was associated with anticipating they would *report to someone else* if they witnessed other student-athletes taking such substances. Specifically, a higher proportion of women than men reported they would *report to someone else*. However, gender was not associated with *confronting the individual* for either substance (nor *joining in* for recreational drugs). Country was not associated with anticipated responses in terms of *reporting to someone else* when witnessing banned APED use, but the comparison between Canada and UK was associated (and marginally associated between USA and UK) in terms of *confronting the individual*. Specifically, a higher proportion of student-athletes in Canada (and marginally higher in USA) anticipated that they would *confront the individual* for banned APED use than counterparts in UK. In terms of recreational drug use, the comparison between Canada and UK was associated with *reporting to someone else* (and comparison between Canada and USA was marginally associated; p = .02), which suggested that a higher proportion of student-athletes in UK (and marginally in the USA) would *report to someone else* if other student-athletes were taking recreational drugs than in Canada. No other associations were noted for recreational drug use apart from a

marginal association (p = .02) suggesting a marginally higher proportion of student-athletes in USA would *confront the individual* if they witnessed another student-athlete taking a recreational drug than in Canada.

Taken together, these findings suggest that gender was associated mainly in terms of whether the student-athlete would anticipate reporting the use of substances to someone else, but not confronting the individual. Moreover, country was associated with how student-athletes anticipated they would respond to other student-athletes taking banned substances, though mainly in terms of confronting the individual.

4.1 Discussion

Within a large cross-national student-athlete sample, this research sought to explore whether country and gender were associated with (1) reported frequency of student-athlete substance use, (2) how frequently student-athletes witnessed peers using specific substances and (3) student-athletes' anticipated responses to addressing peers' substance use. The results underline that substances are indeed being consumed amongst student-athlete populations across national borders as student-athletes in each country reported using and witnessing each of the four substance categories inquired about in this research. In relation to the research aims, the results demonstrate that country was associated with reported use substances (protein, vitamins and minerals, creatine, caffeine and weight loss supplements), witnessed substance use (for each substance category except dietary supplements), and how athletes anticipated addressing each type of substance use by peers. Additionally, gender was associated with self-reported substance use (protein, vitamins and minerals, creatine, caffeine and weight loss supplements), witnessed substance use (dietary supplements and APEDs), and how student-athletes would address peers' substance use (marginal association with dietary supplements).

The associations as a function of country for each variable points to the importance of conducting contextualized research within student-athlete populations and should serve as a word of caution against transferring substance use trends across national borders. Our findings also suggest that prevention education efforts would benefit from being tailored in line with local trends and norms. The lack of awareness regarding substance use trends among UK and Canadian student-athletes is especially concerning as our research demonstrates that substances are being used by student-athletes in both national contexts, albeit to varying extents. Yet, student-athlete substance use trends are currently being monitored only in the US, meaning that the UK and Canada are without evidence to inform targeted education interventions for student-athletes. Future research should monitor UK and Canadian student-athletes' substance use behaviors. One option is to adopt the NCAA Substance Use Survey to their unique contexts and thus serving as a comparison point for the NCAA's findings.

Each of the three countries included in this research reported a higher proportion of using a specific substance compared to the other countries, further emphasizing the importance of conducting contextualized research. The reported use of cannabis clearly reflected some cross-national variation whereby a higher proportion of student-athletes in Canada reported some use of this substance compared to their counterparts in the UK and US. This could potentially be due to the less professionalized nature of collegiate sport in Canada versus the US, but this would not be true in comparison to the UK. Alternatively, the differences in self-reported cannabis use across countries could be reflective of anti-doping education content across the three contexts. US athletes are frequently reminded that cannabis remains banned in sport despite the widespread legalization of recreational cannabis use in the US. In turn, this may have influenced the (lower) frequency of reported cannabis use

among US athletes. Reviewing the content of university targeted anti-doping education across the three countries could provide valuable insights to help explain our findings.

Our findings support our hypothesis as a higher proportion of men self-reported substance use compared to women for all substances, with the exception of (i) vitamins and minerals and (ii) weight loss supplements. It is noticeable that men reported using substances that promote weight gain more regularly than women, whereas women reported greater use of weight loss related substances than men; thus, substantiating existing research (Levitt, 2004; Striegel-Moore et al., 2009, Grossbard et al., 2009; Bratland & Sundgot, 2012). In light of this finding, student-athletes would likely benefit from gender-specific education campaigns and interventions.

The majority of student-athletes had not witnessed the use of uncertified dietary supplements, prescription medications or APEDs but had witnessed recreational drug use whilst at university. Student-athlete focused anti-doping education may benefit from emphasizing banned recreational drugs and should stress (i) which recreational drugs are banned in sport (and when) and (ii) that the intent behind their use (e.g., for partying, academic purposes) is not a justifiable explanation for their use in the anti-doping context. Messages of this nature are especially important given the differing legal statuses of various recreational drugs (e.g., cannabis) on an international level.

Providing important insights for future research, we found country and gender were associated with how student-athletes anticipated addressing substance use by others. Since the majority of student-athletes would "do nothing" unless they witnessed APED use (which they would most likely confront), it is possible that student-athletes are not fully aware of what constitutes "doping". APEDs are the substance category that student-athletes reported witnessing the least, meaning that they are unlikely to address the substances that they reported witnessing the most. This is of concern and suggests that student-athletes would

likely benefit from interventions designed to equip them (i) with broad anti-doping knowledge and (ii) the skills and confidence necessary to take personal responsibility and address substance use in sport. Indeed, the finding that student-athletes were most likely to address APED use via confrontation is consistent with Erickson et al.'s (2017) research and underlines the potential for this approach (confrontation) to be encouraged as an alternative (addition) to whistleblowing on substance use.

4.2 Limitation and future research.

The present findings do need to be considered in light of the study's limitations. The large sample size included student-athletes from three countries, but only a select number of universities within each country. The results may therefore not be generalizable to the wider student-athlete populations across the three countries. This is the first research to document substance use behaviors among UK and Canadian student-athletes and is meant to provide a snapshot of general behaviors across the three countries rather than an overall picture. Second, self-report measures are subject to social desirability bias and the influence of this may be heightened when there are concerns about athletic eligibility (Egan et al., 2016). However, student-athletes were not asked to provide any identifiable information and were informed that the data was being collected anonymously and would at no point be linked back to specific individuals or schools. A limitation of this approach of ensuring anonymity meant we did not ask specifically what team each participant competed in and thereby were unable to conduct multi-level analyses to control for potential within-team norms. Therefore, researchers may wish to measure social desirability alongside approaches that will enable to control for within-team analyses in future studies. Third, in relation to the reporting of witnessed use of substances, it should be acknowledged that this reflects perceived witnessed substance use rather than actual substance use of particular substances as it possible it may be difficult to know the type of some substances for observers (e.g., whether an athletes is taking

a substance due to being prescription or not). It should also be noted approximately 3% of participants reported multiple responses regarding how they anticipate they would respond to witnessing other athletes taking substances despite being asked to report one option. This may suggest that some athletes may consider adopting multiple responses, and potentially participants may respond differently dependent on context (e.g., existing relationship with athlete; perceived consequences of reporting to third party). Therefore, future research may wish to address this issue. A further limitation of this research is that we did not account for potential age differences in relation to substance use. It would be interesting to compare substance use behaviors across the different age-groups (e.g., adolescent vs. adult athletes) as such insights could help determine the most appropriate times to intervene with drug education and determine what content to include (e.g., skills for addressing substance use by others versus information about actual substances). Finally, the survey design did not account for in-season versus out-of-season substance use behaviors. Previous research (Yusko et al., 2008) suggests that substance use is increased during student-athletes' off-seasons, but we have not measured this. Despite these limitations, the findings presented here offer novel insights for US, UK and Canadian university athletic departments and provide much needed insights in relation to each country's student-athlete substance use landscape and culture.

5.1 Conclusion

To the best of our knowledge, this is the first study to explore substance use behaviors in a cross-national sample of student-athletes and the first account of UK and Canadian student-athletes' substance use behaviors, and how they anticipate addressing their peers' substance use. Substance use featured in each national contexts, and our findings provide initial evidence for the role of gender and country in relation to athletes' substance use behaviors, frequency of witnessed substance use and anticipated responses to addressing peers' substance use. The findings caution against the temptation to transfer substance use

trends across national borders and suggest that gender-specific substance use related interventions would be useful. The lack of intention to address peers' substance use behaviors beyond APED-specific substances point to a need for education interventions designed to equip and empower athletes to recognize potentially doping situations and address them appropriately.

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Table 1. Reported supplement use across countries.

Substance	Country	Never		Once a month		Once or more times a week		Chi-Square
		Observed Count	Expected Count	Observed Count	Expected Count	Observed Count	Expected Count	
Protein Supplement	Canada	49 (31%)	62	21 (13%)	23	87 (55%)	71	χ^2 (4) = 16.13*
	US	90 (44%)	81	40 (20%)	30	75 (37%)	93	
	UK	83 (42%)	78	22 (11%)	29	92 (47%)	90	
Vitamin and mineral supplement	Canada	58 (37%)	58	19 (12%)	22	78 (50%)	76	χ^2 (4) = 29.03**
	US	55 (27%)	76	24 (12%)	28	125 (61%)	100	
	UK	94 (48%)	73	34 (17%)	27	68 (35%)	96	
Creatine	Canada	125 (82%)	127	5 (3%)	5	22 (15%)	20	χ^2 (4) = 41.32**
	US	191 (96%)	167	0	7	9 (5%)	26	
	UK	137 (72%)	159	14 (7%)	7	39 (21%)	25	
Caffeine and caffeinated supplements	Canada	122 (78%)	110	11 (7%)	13	24 (15%)	34	χ^2 (4) = 14.79*
	US	153 (74%)	146	13 (6%)	17	41 (20%)	45	
	UK	120 (61%)	139	21 (11%)	16	57 (29%)	43	
Supplements for weight loss	Canada	150 (96%)	140	1 (1%)	6	5 (3%)	10	χ^2 (4) = 26.22**
	US	191 (92%)	185	9 (4%)	8	7 (3%)	14	
	UK	160 (81%)	176	12 (6%)	8	25 (13%)	13	
Cannabis	Canada	114 (81%)	122	27 (19%)	19	0	N/A	χ^2 (2) = 8.06#
	US	173 (86%)	175	29 (14%)	27	0	N/A	
	UK	173 (92%)	163	16 (9%)	26	0	N/A	

Note. Percentage of valid responses for each country are presented in parentheses. As percentages were rounded up some percentages may add up to slightly over 100%. "Don't know" responses were removed from these analyses. N/A reflects that this response was not include in the Chi-Square Analyses due to limited counts for this response. #p < .05, * p <.01, ** $p \leq .001$.

Table 2. Reported supplement use for men and women.

Substance	Gender	Never		Once a month		Once or more times a week		Chi-Square
		Observed Count	Expected Count	Observed Count	Expected Count	Observed Count	Expected Count	
Protein Supplement	Men	85 (29%)	117	37 (13%)	44	173 (59%)	134	$\chi2$ (2) = 45.66**
	Women	137 (52%)	105	46 (18%)	39	80 (30%)	119	
Vitamin and mineral	Men	130 (45%)	109	34 (12%)	41	128 (44%)	142	$\chi2$ (2) = 13.76*
	Women	77 (29%)	98	43 (16%)	36	142 (54%)	128	
Creatine	Men	204 (72%)	237	16 (6%)	10	64 (23%)	37	χ^2 (2) = 60.04**
	Women	248 (97%)	215	3 (1%)	9	6 (2%)	33	
Caffeine and caffeinated supplements	Men	185 (63%)	207	31 (11%)	24	79 (27%)	64	$\chi2$ (2) = 17.06**
	Women	209 (79%)	187	14 (5%)	21	43 (16%)	58	
Supplements for weight loss	Men	276 (93%)	265	7 (2%)	12	13 (4%)	20	$\chi2$ (2) = 9.67*
	Women	224 (85%)	235	15 (6%)	10	24 (9%)	17	
Cannabis	Men	229 (83%)	237	46 (17%)	37	0	N/A	$\chi2$ (1) = 4.88#
	Women	230 (90%)	221	26 (10%)	35	0	N/A	

Note. Percentage of response for each gender are presented in parentheses. As percentages were rounded up some percentages may add up to slightly over 100%. "Don't know" responses were removed from these analyses. N/A reflects that this response was not include in the Chi-Square Analyses due to limited counts for this response. #p < .05, * p <.01, ** $p \leq .001$.

Table 3. Multinomial and binomial logistic regression analyses for substance use

Variable	Multinomial logistical regressions											
	Protein Supplement						Vitamin and minerals					
	Monthly			At least weekly			Monthly			At least weekly		
	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald
Year of School	-0.01	0.99	0.02	0.07	1.08	0.91	-0.13	0.88	1.30	0.01	1.01	0.03
Sport type	0.16	1.18	0.30	0.01	1.01	0.00	-0.17	0.85	0.25	-0.73	0.48	9.79*
Gender	-0.31	0.73	1.37	-1.19	0.30	35.18**	0.76	2.15	7.49*	0.46	1.58	5.21#
Canada vs. UK (Ref)	0.47	1.60	1.73	0.44	1.56	3.23	-0.13	0.69	0.16	0.55	1.74	5.10#
USA vs. UK (Ref)	0.56	3.14	1.76	-0.10	0.91	0.17	0.02	0.98	0.01	0.99	2.70	17.40**
USA vs. Canada (Ref)	0.94	1.10	0.08	-0.54	0.58	4.62#	0.11	1.11	0.16	-0.44	0.58	5.10
Model χ^2 (model fit)	53.37**						54.28**					
Cox & Snell R^2	.09						.10					
Nagelkerke R^2	.11						.11					

Variable	Binomial logistic regressions											
	Creatine			Caffeine supplements			Weight loss supplements			Cannabis		
	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald
Year of school	0.02	1.02	0.03	0.06	1.06	0.57	0.10	1.10	0.76	0.25	1.29	6.45#
Sport type	0.57	1.77	2.37	0.02	1.02	0.01	0.19	1.21	0.30	0.06	1.06	0.03
Gender	-2.19	0.11	34.27**	-0.73	0.48	13.03**	1.15	3.15	13.51**	-0.64	0.53	5.24#
Canada vs. UK (Ref)	-0.59	0.56	4.04#	-0.90	0.41	12.61**	-2.01	0.13	16.38**	0.98	2.65	7.29*
USA vs. UK (Ref)	-1.95	0.14	22.53**	-0.50	0.61	4.93#	-1.23	0.29	13.36**	0.91	2.48	6.53#
USA vs. Canada (Ref)	-1.36	0.26	9.71*	0.39	1.48	2.20	0.78	2.18	2.16	-0.07	0.93	0.05
Model χ^2	104.21**			30.31**			40.48**			17.52**		
Cox & Snell R^2	.18			.05			.07			.03		
Nagelkerke R^2	.30			.08			.15			.06		

Note. "Never" was included as the reference category for each dependent variable. One model included dummy codes for Canada and USA (code = 1), so the UK (code = 0) as the reference country, then in a separate model UK and USA were dummy coded (code = 1), and Canada was the reference country (code = 0) for the comparison between USA and Canada. #p < .05, * p <.01, ** $p \leq .001$

Table 4. Frequency that student-athletes have witnessed athletes taking substances across countries.

Substance	Country/ Gender	Variable	Never		At least once		Chi-Square
			Observed Count	Expected Count	Observed Count	Expected Count	
Dietary supplement	Country	Canada	120 (76%)	127	38 (24%)	31	χ^2 (2) = 3.02
		US	169 (82%)	165	36 (18%)	40	
		UK	159 (82%)	156	34 (18%)	38	
	Gender	Men	218 (75%)	235	74 (25%)	57	χ^2 (1) = 13.61**
		Women	229 (87%)	212	34 (13%)	51	
Prescription medication	Country	Canada	95 (66%)	106	50 (34%)	39	χ^2 (2) = 21.96**
		US	134 (67%)	146	65 (33%)	53	
		UK	162 (85%)	139	28 (15%)	51	
	Gender	Men	203 (74%)	202	73 (26%)	74	χ^2 (1) = 0.04
		Women	187 (73%)	188	70 (27%)	69	
Banned APEDs	Country	Canada	131 (85%)	140	24 (16%)	15	χ^2 (2) = 16.17**
		US	199 (97%)	186	7 (3%)	20	
		UK	174 (88%)	178	23 (12%)	19	
	Gender	Men	254 (86%)	266	41 (14%)	29	χ^2 (1) = 12.66**
		Women	249 (95%)	237	13 (5%)	25	
Recreational drugs	Country	Canada	33 (21%)	48	125 (79%)	110	χ^2 (2) = 9.88*
		US	67 (32%)	63	141 (68%)	145	
		UK	72 (36%)	61	`129 (64%)	140	
	Gender	Men	91 (30%)	91	208 (70%)	208	χ^2 (1) = 0.98

		Women	81 (30%)	81	186 (70%)	186	

Note. Percentage of response within each country and gender are presented in parentheses. As percentages were rounded up some percentages may add up to slightly over 100%.* $p < .01$, ** $p \leq .001$.

Table 5. Binomial logistic regression for frequency that student-athletes reported witnessing athletes taking substances.

Variable	Dietary Supplement			Prescription medication			Banned APEDs			Recreational drugs		
	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald
Year of school	0.22	1.25	6.92*	0.18	1.20	5.16#	0.11	1.11	0.88	0.38	1.46	20.64**
Sport type	0.22	1.25	0.68	0.32	1.37	1.75	0.41	1.50	0.96	0.02	0.94	0.01
Gender	-0.90	0.41	14.02**	-0.07	0.94	0.10	-1.13	0.32	9.70*	-0.07	0.93	0.12
Canada vs. UK (Ref)	0.48	1.61	2.89	1.15	3.14	17.05**	0.45	1.57	1.82	0.80	2.22	9.97*
USA vs. UK (Ref)	0.32	1.37	1.28	1.17	3.22	19.02**	-0.94	0.39	4.16#	0.32	1.38	2.08
USA vs. Canada (Ref)	-0.16	0.85	0.33	0.02	0.93	0.10	-1.39	0.25	9.26*	-0.48	0.62	3.45
Model χ^2	23.23**			29.17**			29.33**			32.03**		
Cox & Snell R^2	.04			.05			.05			.06		
Nagelkerke R^2	.07			.08			.11			.08		

Note. "Never" was included as the reference category for each dependent variable. The first model included dummy codes for Canada and USA so the UK was the reference country, then a subsequent model the UK and USA dummy codes so Canada was the reference country for comparison between USA and Canada. #p < .05, *p <.01, **$p \leq .001$.

Table 6. Frequencies for how athletes' would respond to witnessing other student-athletes taking substances.

Substance	Country/ Gender	Variable	Do Nothing		Report to someone (including authorities)		Confront Individual		Join in		Chi-Square
			Observed Count	Expected Count	Observed Count	Expected Count	Observed Count	Expected Count	Observed Count	Expected Count	
Dietary supplement	Country	Canada	89 (56%)	94	16 (10%)	17	53 (34%)	47	0	N/A	χ^2 (4) = 16.11*
		USA	115 (56%)	123	17 (8%)	22	75 (36%)	61	0	N/A	
		UK	131 (66%)	118	28 (14%)	22	39 (20%)	59	1 (1%)	N/A	
	Gender	Men	192 (65%)	177	25 (8%)	32	80 (27%)	88	1 (<1%)	N/A	χ^2 (2) = 7.57#
		Women	143 (54%)	158	36 (14%)	29	86 (33%)	78		N/A	
Prescription medication	Country	Canada	82 (52%)	88	12 (8%)	20	65 (41%)	51	0	N/A	χ^2 (4) = 9.41**
		USA	105 (51%)	115	28 (14%)	26	73 (35%)	66	1 (1%)	N/A	
		UK	127 (64%)	111	30 (15%)	25	43 (22%)	64	0	N/A	
	Gender	Men	185 (62%)	166	26 (9%)	37	88 (29%)	96		N/A	χ^2 (2) = 13.15**
		Women	128 (48%)	147	44 (17%)	33	93 (35%)	85	1 (<1%)	NA	
Banned APEDs	Country	Canada	30 (20%)	40	39 (26%)	48	83 (55%)	65	0	N/A	χ^2 (4) = 19.83**
		USA	46 (23%)	53	75 (37%)	64	83 (41%)	87	0	N/A	
		UK	68 (34%)	52	60 (30%)	62	70 (35%)	84	0	N/A	
	Gender	Men	93 (32%)	76	56 (19%)	92	143 (49%)	124		N/A	χ^2 (2) = 43.81**
		Women	51 (20%)	68	118 (45%)	82	92 (35%)	111		N/A	
Recreational drugs	Country	Canada	108 (68%)	95	4 (3%)	13	36 (23%)	41	11 (7%)	10	χ^2 (4) = 18.69*
		USA	114 (55%)	124	21 (11%)	16	65 (31%)	53	8 (4%)	13	
		UK	117 (59%)	119	21 (11%)	16	44 (22%)	51	17 (9%)	13	
	Gender	Men	193 (65%)	179	13 (4%)	24	73 (25%)	76	18 (6%)	19	χ^2 (3) = 13.01*
		Women	146 (55%)	161	32 (12%)	21	71 (27%)	68	18 (7%)	17	

Note. Percentage of response within country and gender are presented in parentheses. As percentages were rounded up some percentages may add up to slightly over 100%. "N/A" reflects that this response was not include in the Chi-Square Analyses due to limited counts for this response. Ay multiple responses were removed from the Chi-Square analyses. #p < .05, *$p \leq .01$, **$p \leq .001$.

Table 7. Multinomial regressions for how student-athletes would respond to witnessing other athletes taking substances.

Variable	Dietary Supplement						Prescription					
	Report to someone			Confront Individual			Report to someone			Confront individual		
	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald
Year of school	-0.25	0.78	4.03#	0.06	1.07	0.70	-0.22	0.80	3.62	-0.05	0.95	0.39
Sport type	-0.43	0.65	1.91	-0.13	0.88	0.31	-0.12	1.13	0.16	-0.06	0.94	0.07
Gender	0.75	2.11	6.42#	0.28	1.32	1.90	0.93	2.53	10.81**	0.36	1.44	3.38
Canada vs. UK (Ref)	-0.21	0.81	0.35	0.65	1.92	6.48#	-0.49	0.61	1.71	0.86	2.37	12.13**
USA vs. UK (Ref)	-0.68	0.51	3.78	0.71	2.02	8.31*	-0.11	0.89	0.14	0.63	1.88	6.75*
USA vs. Canada (Ref)	-0.47	0.62	1.48	0.05	1.05	0.05	0.38	1.46	0.96	-0.23	0.79	0.99
Model χ^2 (model fit)	30.52**						35.91**					
Cox & Snell R^2	.05						.06					
Nagelkerke R^2	.06						.07					

Variable	Banned APEDs						Recreational drugs								
	Report to someone			Confront Individual			Report to someone			Confront individual			Join in		
	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald	B	OR	Wald
Year of school	-0.11	0.89	1.33	0.15	1.16	2.98	-0.35	0.71	5.08#	0.04	1.04	0.26	0.13	1.13	0.84
Type of sport	-0.25	0.78	0.85	0.05	1.06	0.04	0.68	1.97	2.80	0.38	1.46	2.60	0.75	2.12	2.49
Gender	1.33	3.77	28.55**	0.11	1.11	0.21	1.32	3.73	12.98**	0.23	1.26	1.26	0.56	1.76	2.27
Canada vs. UK (Ref)	0.40	1.50	1.58	1.12	3.08	15.46**	-1.67	0.19	8.65*	-0.18	0.83	0.48	-0.57	0.57	1.67
USA vs. UK (Ref)	0.26	1.30	0.92	0.56	1.74	4.50#	-0.35	0.70	0.93	0.41	1.50	2.72	-0.71	0.49	2.34
USA vs. Canada (Ref)	-0.14	0.87	0.18	-0.57	0.57	3.69	1.32	5.31	5.23#	0.59	1.81	5.31#	-0.15	0.87	0.08
Model χ^2 (model fit)	72.16**						48.14**								
Cox & Snell R^2	.13						.08								
Nagelkerke R^2	.14						.10								

Note. "Do nothing" was included as the reference category for each dependent variable. The first model included dummy codes for Canada and USA so the UK was the reference country, then a subsequent model whereby UK and USA dummy codes so Canada was the reference country for comparison between USA and Canada. #p < .05, *$p \leq .01$, **$p \leq .001$.