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Randomized Controlled Trial of a Novel Peer Concussion-Education Program for Collegiate Athletes

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Context: The National Collegiate Athletic Association and US Department of Defense have called for educational programs to change the culture of concussion reporting, increase reporting behavior, and enhance the safety of players and service members.

Objective: To evaluate the effects of a novel peer concussion-education program (PCEP) in changing knowledge, attitudes, and norms about concussion reporting among collegiate student-athletes and assess program implementation.

Design: Randomized controlled trial and qualitative analysis of interviews.

Setting: National Collegiate Athletic Association athletic teams from randomly selected colleges or universities.

Patients or Other Participants: A total of 1614 male and female student-athletes from 60 teams at 10 colleges and universities and 8 athletic trainers.

Intervention(s): The PCEP intervention trains 2 peer concussion educators to provide 2 education modules to their teammates. Knowledge, attitudes (oneself and teammates), and concussion occurrence or reporting were assessed at baseline, postintervention, and 1 month later. Eight athletic trainers were interviewed about program implementation.

Results: Compared with the control group, the intervention group showed greater increases occurred postintervention and at 1 month in concussion knowledge ($F_{1,2648} = 51.3$, $P < .0001$), intention to report (oneself, $F_{2,2633} = 82.3$, $P < .0001$; teammates, $F_{2,2624} = 53.9$, $P < .0001$), return-to-play protocol knowledge, ($F_{2,2632} = 28.4$, $P < .0001$), direct subjective norms (oneself, $F_{2,2625} = 51.7$, $P < .0001$; teammates, $F_{2,2644} = 40.6$, $P < .0001$), direct perceived behavioral control (oneself, $F_{2,2628} = 53.7$, $P < .0001$; teammates, $F_{2,2615} = 68.2$, $P < .0001$), and indirect attitudes (oneself, $F_{2,2626} = 47.1$, $P < .001$; teammates, $F_{2,2623} = 40.9$, $P < .0001$). Peer concussion-education program participants discussed concussion more often with a teammate ($F_{1,1396} = 13.96$, $P < .0001$) or athletic staff ($F_{1,1396} = 6.62$, $P < .001$). Qualitative program analysis revealed both positive aspects of the PCEP and areas for improvement.

Conclusions: The PCEP showed promise in increasing concussion knowledge, intention to report concussion, reporting a teammate's concussion, and facilitating attitudinal changes that support reporting among student-athletes.

Key Words: mild traumatic brain injuries, randomized trial, concussion reporting, attitudes

Key Points

- Peer concussion education about pathophysiology and cognitive-behavioral change models show promise in increasing reporting intention and knowledge of symptoms and facilitating positive changes in attitudes toward concussion.
- Participation in a peer concussion-education program increased discussion of concussions with peers, coaches, and athletic trainers.
- Athletic trainers who implemented the peer concussion-education program reported positive experiences using well-organized and engaging materials and clear guidelines for peer selection.

More than 460 000 student-athletes compete in 24 National Collegiate Athletic Association (NCAA) sports every year,[1] and estimates of concussions are 0.43 to 0.57 per 1000 athlete-exposures (game or practice) for these individuals,[2,3] with rates varying by sport and sex.[4] The data on concussion prevalence rely on student-athletes' self-report, which is likely to be affected by factors such as the culture surrounding athletics.[5] About 25% of collegiate student-athletes reported pressure from others to continue playing despite an impact to the head.[6] Moreover, one-half to two-thirds of student-athletes stated that they would continue to play with possible symptoms of a concussion,[6–8] which is alarming because continuing to play while symptomatic puts athletes at risk for significant neurologic consequences.[9]

Current Approaches to Changing Concussion Reporting

Current concussion-education programs have focused on increasing knowledge about the physiology, symptoms, and health consequences of concussion in student-atheletes.[10–11] However, knowledge was a distal predictor of behavior,[12] and increased concussion knowledge was only weakly associated with reporting behavior.[6,13,14] Greater change is needed consistent with a culture of safety,[5,6] including increasing concussion reporting and compliance with return-to-play (RTP) protocols.[5]

The conceptual framework of the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)[12] has been applied to understanding the attitudes and norms influencing concussion reporting.[13,14] This theory posits that the relationship of knowledge to behavioral change is mediated by changes in cognitions that are more proximal (ie, intention to report) and intermediate (ie, attitudes, subjective norms, perceived behavioral control) to behavior.[12] *Attitudes* are the cognitive-affective beliefs about concussion reporting; *subjective norms* are expectations the reference group holds for concussion reporting; *behavioral control* is the perception of the ability to carry out the behavior. These indicators can be direct (ie, for oneself) or indirect (ie, perceived in others, such as coaches or peers) and combine to predict *intention*, which is the belief that one will perform the behavior when the situation arises. Cognitive-behavioral interventions are well suited to help individuals modify attitudes and beliefs that perpetuate problematic behaviors such as the failure to report a concussion.[15] Health-related behavioral adherence has been increased using cognitive-behavioral methods, whereas changing knowledge alone was insufficient.[12,15] Studies[12–14] of cognitive-behavioral interventions using a TRA or TPB framework demonstrated that changes in attitudes, norms, beliefs, and intentions significantly influenced athletes' reporting behavior.

An Approach to Changing Concussion Reporting

To attain normative and attitudinal change, it is necessary to consider the factors affecting concussion reporting in collegiate athletes.[16] Typical concussion-education programs use a "top-down" approach in which authority figures (eg, athletic trainers, neuropsychologists) deliver the intervention.[11] An alternative to this traditional top-down approach is the use of peer-mediated programs in which individuals from the target population lead the intervention. Because peers have the most contact with one another and are critical to the development and maintenance of attitudes, norms, and beliefs,[14] peer interventions may be especially influential in not only challenging cognitions but changing norms for reporting and enhancing reporting.[11] Models using peer-mediated programs have demonstrated a wide range of positive outcomes in diverse populations.[17–19] In addition, the involvement of multiple stakeholders through an interdisciplinary model consistent with the socioecological framework,[20] which includes the intrapersonal (ie, the athlete themselves), interpersonal (eg, coaches, athletic trainers), and environmental (eg, sports culture, access to prevention material) levels, further supports positive change at all levels. Thus, an interdisciplinary model that includes multiple stakeholders is likely to be more effective than a single top-down approach.

Using a peer-mediated, interdisciplinary, cognitive-behavioral approach, the Peer Concussion Education Program (PCEP) was developed in response to a call for novel interventions from the NCAA and US Department of Defense. The present study was a nationwide randomized controlled trial (RCT) designed to evaluate the effect of a novel PCEP among NCAA student-athletes competing in sports with a high risk of concussion. Our purpose was to compare the PCEP intervention and a control condition for changes in concussion knowledge, reporting behaviors, attitudes, intentions around reporting behaviors, discussion of concussion with others, and reporting behaviors after the intervention and 1 month later. Additionally, we solicited feedback from athletic trainers who implemented the PCEP to describe important themes encountered in carrying out the intervention.

METHODS

Participants

Schools. The Consolidated Standards of Reporting Trials (CONSORT) table in the Figure illustrates the enrollment of institutions and randomization of teams to conditions. First, colleges and universities were sampled randomly if they (a) were a member of the NCAA, (b) had a men's football team, (c) had at least 2 of the following NCAA additional men's sports: baseball, basketball, ice hockey, lacrosse, soccer, or wrestling, and (d) had at least 3 of the following women's sports: basketball, field hockey, ice hockey, lacrosse, soccer, or softball. These sports were chosen because they have been identified as having the highest rates of concussion for each sex.[4] From this pool, a multistage cluster-sampling technique was used to ensure representation of key variables in the final sample (including NCAA Division [I, II, III]; enrollment [$<$5000, $\geq$5000]; geographic location [Northeast, Midwest, South, West]; and funding source [public, private]).

Second, we contacted the athletic director and head athletic trainer for 42 randomly selected schools. Eighteen schools did not respond within the 2-week timeframe after 3 attempts at contact. A total of 24 institutions responded, and 10 schools (Division I = 3, Division II = 4, Division III = 3) initiated an agreement with the research team, received local ethical board approval, and were enrolled in the study. Student-athletes and athletic trainers who provided data all supplied informed consent and were free to decline to participate in any aspect of the study without penalty. Finally, within each institution, 6 individual teams meeting the inclusion criteria (3 men's, 3 women's) were randomized to receive either the experimental (PCEP) or control (routine concussion education mandated by the NCAA and implemented individually on each college campus) condition. Random assignment to condition was counterbalanced for sex within school and NCAA Division.

Student-Athletes. A total of 1614 student-athletes (773 in the experimental group, 841 in the control group) participated in the study: 389 competed in Division I, 794 in Division II, and 431 in Division III. Ethnicity was described by 364 individuals as African American, 18 as Asian, 1206 as European American, 50 as Latino or Latina, 10 as Native American, and 19 as mixed or another identity.[a] The average age of participants was 19.8 years (SD = 1.33, range = 18–27 years). Table 1 presents participants by sport and sex. Men were overrepresented due to the inclusion of football at every school and the larger roster sizes of football. A total of 528 (32.9%) student-athletes were freshmen, 468 (29.2%) were sophomores, 426 (26.5%) were juniors, 150 (9.4%) were seniors, and 34 (2.1%) were fifth-year and above students. Student-athletes reported having played their sport for an average of

[a] Participants were permitted to choose multiple ethnicities, so percentages are not available.

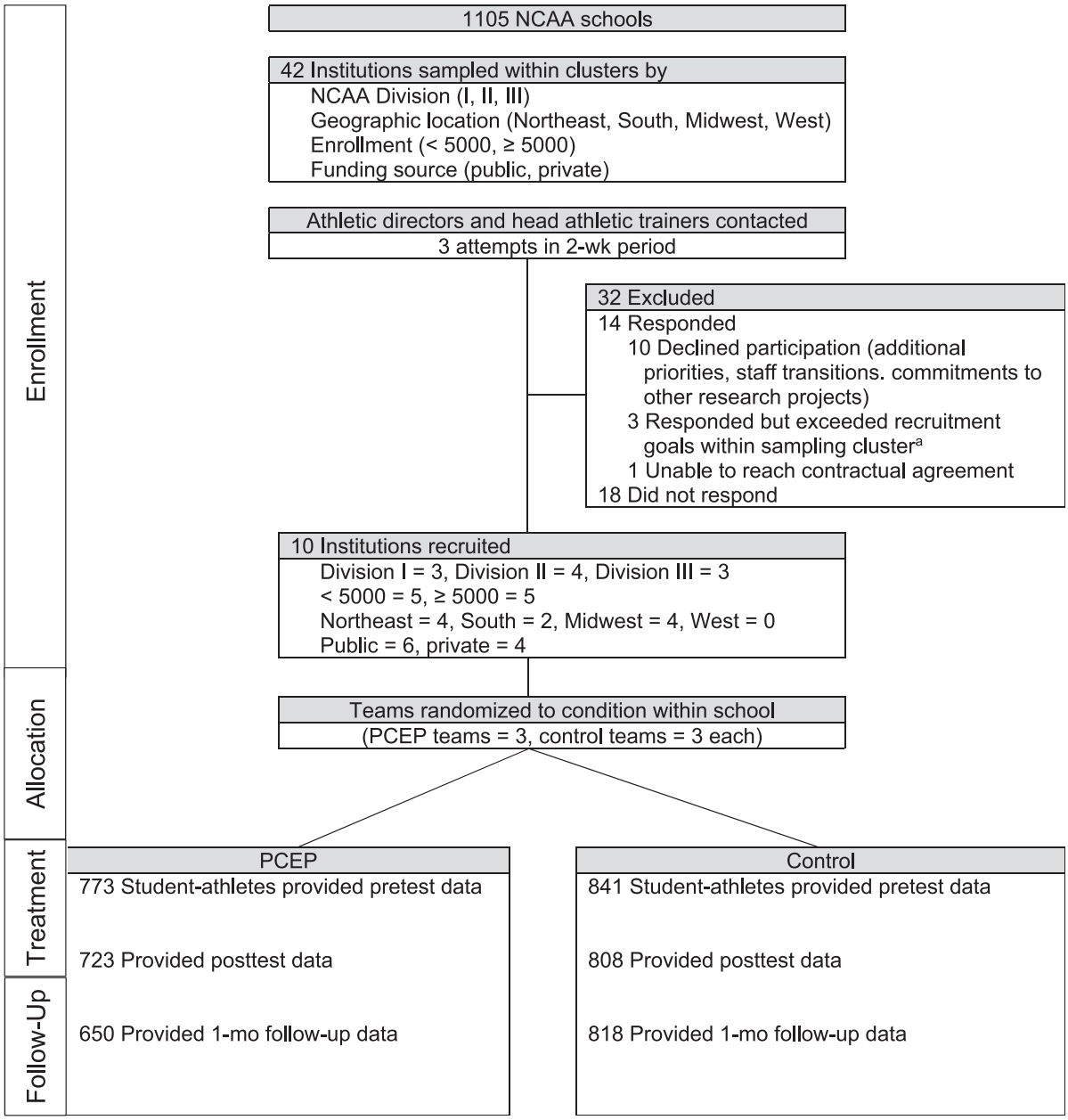

Figure. Consolidated Standards of Reporting Trials study flowchart. [a] Responded but exceeded recruitment goals indicates that a site may have expressed interest in participation, but that cluster or division had already been fulfilled.

10.7 years (SD = 4.96, range = 0–21 years). Thirty-two percent (n = 515) of students reported participating in a previous concussion-education program, 54% (n = 847) never experienced previous concussion education, and 14% (n = 222) were uncertain whether they had. Concussion history was assessed through self-report at baseline in the demographic portion of data collection via the question, "Have you ever had a concussion?" Half of student-athletes reported *no* (n = 824; 51.2%), 40.3% (n = 648) reported *yes*, and 8.6% (n = 138) were *not sure*. The PCEP and control conditions did not differ with respect to concussion history ($\chi^2_{2,\ 1610} = 1.68$, $P = .43$).

Table 1. Frequencies of Women and Men Participating by Sport

Sport	Women (n = 511)	Men (n = 1103)
Baseball	NA	117
Basketball	92	60
Field hockey	28	NA
Football	NA	666
Ice hockey	21	17
Lacrosse	72	53
Soccer	164	117
Softball	134	NA
Wrestling	NA	73

Abbreviation: NA, not applicable.

Athletic Trainers. Eight athletic trainers from the 10 colleges and universities participated in a debriefing of the PCEP implementation after completing the program.

Intervention

The development of the PCEP was influenced by the TRA or TRB and uses a peer-mediated, cognitive-behavioral, and interdisciplinary model to enhance concus-

sion knowledge and reporting.[11,15,20] Consistent with the TRA or TRB,[14] the PCEP not only focuses on enhancing concussion knowledge but also attempts to address attitudes and team norms to enhance concussion reporting. Two student-athletes per team were selected to serve as peer concussion educators (PCEs) by their coach, athletic trainer, and an athletic department administrator. The PCEs were trained by an athletic trainer to provide an education module via a slide presentation designed to enhance concussion knowledge and a second module designed to enhance concussion reporting. The second module features worksheet exercises that require student-athletes to list cognitions that inhibit reporting and replace them with cognitions that facilitate reporting by oneself and one's teammates. After completing their training, the PCEs provided both education modules to their teammates and were encouraged to facilitate discussion about concussion and concussion reporting. A more detailed description about the PCEP and its development is provided in the article by Ernst and Kneavel[21] or by clicking on the following link: chc.edu/peer-concussion-education/peer-concussion-education-program-manual.

Assessments

Knowledge Measures. Knowledge of concussion symptoms was assessed using a symptom checklist from the Acute Concussion Evaluation[22] and nonsymptoms from a survey developed by Valovich McLeod et al.[23] The checklist consisted of 27 items, with 19 true symptoms (eg, blurred vision, headache) and 8 false symptoms (eg, black eye, chest pain). Scores reflect the number of actual symptoms endorsed and the number of incorrect symptoms not endorsed (Table 2). Knowledge of the RTP protocol was assessed using a 5-item Likert scale questionnaire (Table 2).

Attitude Measures Based on the TPB or TRA. An adapted version of a TPB questionnaire[24] for concussion reporting by Register-Mihalik et al[13] contained subscales to measure (a) intention to report concussion and (b) direct attitudes (individual's attitudes about reporting), (c) direct perceived behavioral control (whether individuals feel they are able to report), (d) indirect attitude (the possible consequences of reporting), and (e) indirect perceived behavioral control (pressures about concussion reporting from others such as coaches, fans, and parents). See Table 3 for an overview of the assessments, timelines, and description of the measure and Table 2 for the specific assessments used. The questionnaire was first modified to include questions about reporting a suspected concussion in oneself and one's teammates for each subscale. The intention-to-report subscale was altered to include questions about context (ie, *under most circumstances*, *even if I am not sure it is serious*, *to make an effort to report*, *when I notice symptoms*, *in a playoff or championship game*, *in practice*) to account for the potential influence of circumstances. Two questions were added to the Perceived Behavioral Control subscale relevant to the current study (ie, *the encouragement of my teammates makes it easier to report*, *having a peer concussion educator makes it easier to report*). The adapted versions were reviewed by the studies' coprincipal investigators, who have expertise in concussion and program assessment. Moreover, the assessment measures were reviewed by a researcher affiliated with the NCAA Sports Science Institute who has expertise in concussion research.

Concussion Occurrence and Reporting. Finally, at 1-month follow up, all student-athletes described concussion occurrence and reporting in the month since posttest. Participants answered questions about whether they suspected or knew of a concussion in self or teammate; whether they spoke with teammates, peer educators or knowledgeable peers, coaches, or athletic trainers about concussions; and whether they reported a concussion that they experienced or witnessed (Table 2).

Procedure

After being randomly selected and agreeing to participate in the study, the site study coordinator from each college or university was e-mailed an enrollment packet that consisted of an overview of the study protocol, assessment measures, and access to the PCEP online manual. Next, a phone conference with each study site coordinator was conducted by 1 of the coprincipal investigators to review the contents of the enrollment packet and foster adherence to the study protocol across all 10 participating colleges or universities. The phone conference allowed us to ensure functionality of the online manual for the potential participants and describe the 4-step process for selecting and training peer educators and having peer educators present to their teammates. It also was done to familiarize participants with the study materials and assessments and to answer any questions about the study protocol.

After the enrollment meeting, the study site coordinators followed the PCEP implementation process outlined in the online manual with the individual teams within a school randomly assigned to the experimental group, which included (a) forming an interdisciplinary implementation team, (b) selecting the PCEs, (c) training the PCEs, and (d) having the PCEs present the 2 modules to their teammates. The goal of the study was to evaluate the utility of the PCEP as it would be used on college campuses. Thus, the site coordinators implemented the program for teams in a way that worked with those teams' schedules, usually aligning it with team meetings. The PCEs were typically trained 1 to 2 weeks before the implementation of the PCEP, following the recommendations outlined in the online manual. Assessments occurred immediately before the PCEP was administered (baseline), immediately after the PCE presentation to teammates (or after an equivalent length of time for those teams in the control condition: *posttest*), and after 1 month (follow up) for all treatment conditions. Study site coordinators scheduled all treatment, control, and assessment times. The data for each student-athlete were linked over the 3 timepoints by a unique identifier. All assessments used a paper-and-pencil format. The control condition had similar assessment schedules.

The control groups did not receive any experimental intervention. External site study personnel were instructed to advise the PCEs and the teams participating in the PCEP to avoid discussing the program with control-group participants or any other students or student-athletes at their school. During the time intervals, which mimicked the time between baseline and the immediate posttest for the PCEP groups, control teams engaged in standard athletic

Table 2. Assessments[a] Continued in Next Column

Concussion knowledge
- Amnesia (memory loss)
- Bleeding from the mouth
- Difficulty breathing
- Drowsiness
- Irritability
- Nausea
- Sensitivity to noise
- Blurred vision
- Bleeding from the nose
- Difficulty concentrating
- Fatigue
- Loss of consciousness
- Nervousness
- Sharp burning in the neck
- Black eye
- Chest pain
- Distractibility
- Feeling "foggy"
- Loss of neck range of motion
- Sadness
- Sleep disturbance
- Bleeding from the ear
- Confusion
- Dizziness
- Headache
- More emotional
- Sensitivity to light

Return-to-play protocol knowledge (5-point Likert scale from *never* to *always* except where noted)
- How well do you understand the return-to-play protocol for concussion? (5-point Likert scale from *not at all* to *very well*)
- Light cardio exercise can be initiated while symptoms of a concussion are still occurring.
- A full-contact practice is required before returning to competition.
- Clearance by a health care professional is required before returning to full participation.
- The athlete could still have some symptoms but return to practice.

Intention to report (self; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When I myself experience possible concussion symptoms:
- I intend to report under most circumstances.
- I plan to report even if I am not sure it is serious.
- I will make an effort to report.
- I plan to report when I notice symptoms.
- I will report if it happens in a playoff or championship game.
- I intend to report in a practice.

Intention to report (teammate; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When my teammate experiences possible concussion symptoms:
- I intend to report under most circumstances.
- I plan to report even if I am not sure it is serious.
- I will make an effort to report.
- I plan to report when I notice symptoms.
- I will report if it happens in a playoff or championship game.
- I intend to report in a practice.

Direct subjective norms (self; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When I myself experience possible concussion symptoms:
- My coach believes I should report.
- My teammates believe I should report.
- My trainer thinks I should report.
- It is expected of me to report.

Table 2. Continued From Previous Column

Direct subjective norms (teammate; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When my teammate experiences possible concussion symptoms:
- My coach believes I should report.
- My teammates believe I should report.
- My trainer thinks I should report.
- It is expected of me to report.

Direct perceived behavioral control (self; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When I myself experience possible concussion symptoms:
- I am confident I could report.
- I have control over reporting.
- I am able to report.
- The encouragement of my teammates makes it easier to report.
- Having a peer concussion educator makes it easier to report.

Direct perceived behavioral control (teammate; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When my teammate experiences possible concussion symptoms:
- I am confident I could report.
- I have control over reporting.
- I am able to report.
- The encouragement of my teammates makes it easier to report.
- Having a peer concussion educator makes it easier to report.

Indirect perceived behavioral control (self; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When I myself experience possible concussion symptoms:
- Reporting will improve my athletic performance.
- Reporting will reduce the chances of my suffering another concussion.
- Reporting will cause me to lose my position on the team (R).
- Reporting will cause me to lose playing time (R).
- Reporting will help me maintain my health.
- Reporting will help me maintain my school performance.
- Reporting will let my teammates down (R).

Indirect perceived behavioral control (teammate; 7-point Likert scale from *strongly disagree* to *strongly agree*)
- When my teammate experiences possible concussion symptoms:
- Reporting will improve my teammate's athletic performance.
- Reporting will reduce the chances of my teammate suffering another concussion.
- Reporting will cause my teammate to lose their position on the team (R).
- Reporting will cause my teammate to lose playing time (R).
- Reporting will help my teammate maintain their health.
- Reporting will help maintain my teammate's school performance.
- Reporting will let my teammates down (R).

Concussion occurrence and reporting (*yes* or *no* response)
- Please indicate any of the following you have experienced in the last month. If you have answer yes to any question, please give a brief (2–3 sentence) description of what you experienced.
- In the past month:
- I have seen someone in practice or competition sustain athletic contact, a collision, fall, or head injury.
- I myself in practice or competition have sustained athletic contact, a collision, fall, or head injury.
- I myself have experienced symptoms of a concussion.
- I have seen a teammate experience symptoms of a concussion.
- I have discussed concussions with my teammate(s).
- I have discussed concussions with my coach(es).
- I have discussed concussions with a trainer.
- I have discussed concussions with a peer concussion educator or another student knowledgeable about concussion injuries.
- I myself have sustained a concussion.
- I suspected a concussion in myself.
- If you answered yes to the previous question, did you report it?
- I suspected a concussion in a teammate.
- If you answered yes to the previous question, did you report it?

[a] Items are presented in their original format. (R) indicates the item was reverse scored.

Table 3. Assessments, Modifications, Timeline, and Theory of Reasoned Action or Theory of Planned Behavior[a]

Outcome Measure or Theory of Reasoned Action or Planned Behavior Construct	Outcome Assessed or Description	Description or Modification	Assessment Point(s)
Demographics	Demographic information	Demographic questions to determine age, sports played, history of concussions, sex, etc	Baseline
Concussion knowledge	Concussion knowledge or ACE checklist modified from Gioia and Collins[22] (2006) and McLeod et al[23] (2007)	Total items = 27, 19 true symptoms of concussion from ACE checklist and nonsymptoms from McLeod et al.[23] Participants received 1 point for each item that was correctly identified as a symptom or not a symptom of concussion.	Baseline Postintervention 1-mo Follow up
Knowledge of RTP protocol	Knowledge of RTP protocol	Five-item questionnaire based on Module 1 content. A 5-point Likert scale is used to assess knowledge of RTP protocol.	Baseline Postintervention 1-mo Follow up
Intention modified from the original 3-item questionnaire of Register-Mihalik et al[13] (2013)	Intention to report	The 12-item questionnaire was modified from the original 3 questions and expanded to include intention under general and specific circumstances such as *practice*, *playoff*, *even if I am not sure it is serious*, etc. A 7-point Likert scale was used to assess intention to report in oneself (6 items) or one's teammates (6 items).	Baseline Postintervention 1-mo Follow up
Direct subjective norms scale modified from Register-Mihalik et al[13] (2013)	What important others around the athlete believe about reporting	Eight items about what important others think were modified to be more specific (*people I know* changed to *coach*, *teammates*, *trainer*, *it is expected of me*) for oneself (4 items) or one's teammate (4 items). Participants indicated their agreement with each statement on a 7-point Likert scale.	Baseline Postintervention 1-mo Follow up
Direct perceived behavioral control questionnaire modified from Register-Mihalik et al[13] (2013)	Ability to report or how able the athlete feels to actually carry out the reporting behavior	Ten items address one's perceived ability to report a concussion in oneself (5 items) or one's teammates (5 items). Participants indicated their agreement with each statement on a 7-point scale. Two items were changed from the original scale to Likert scale (*I have control over reporting* and *I am able to report*), and 2 items were added (*the encouragement of my teammates makes it easier to report* and *having a peer concussion educator makes it easier to report*).	Baseline Postintervention 1-mo Follow up
Indirect attitude modified from Register-Mihalik et al[13] (2013)	Consequences of reporting	Fourteen items address beliefs about reporting their own (7 items) or a teammate's (7 items) concussion. Items taken directly from the original. Items from the original construct with *extremely good* or *extremely bad* Likert-scale formats were excluded. Participants indicated their agreement with each statement on a 7-point Likert scale.	Baseline Postintervention 1-mo Follow up
Concussion occurrence and reporting	Suspected occurrences of concussions in the last month in oneself and one's teammates, including if participants reported concussions	Thirteen items designed to address suspected concussions; discussions with trainers, teammates, and coaches about concussions; and self- and teammate-reported concussions over the study time period. Questions use a dichotomous *yes* or *no* format and include open-ended format for additional information.	1-mo Follow up only

Abbreviations: ACE, acute concussion evaluation; RTP, return-to-play.

[a] Items are presented in their original format.

activities including practice, strength training, and team meetings at the discretion of the site coordinator to accommodate challenging time demands and other logistics associated with student-athletes and athletic department staff.

All student-athletes gave informed consent for the research procedures. Because all recruits were also student-athletes, participation in the routine concussion-education programming provided by their school was required by the NCAA, whether the student-athletes were in the experimental or control condition. The NCAA-mandated routine concussion education occurred outside of the study and fell under the purview of each individual university or college, regardless of the student-athletes' participation in the PCEP or control condition. The PCEP was designed to supplement and not replace the current NCAA-mandated training. The current NCAA training was not part of the control condition. Participation in the PCEP

or any of the study assessments was voluntary as a condition of institutional review board approval.

Statistical Analysis

To account for the nesting in the student-athlete data (timepoint, within student-athlete, within school, within division), mixed-effects multilevel models (MLMs) were run for each measure separately with random intercepts for student-athlete, school, and division. Time (baseline, posttest, follow up), treatment condition, and the interaction of time and condition were treated as fixed effects.[b] Because the main variable of interest was the effect of the PCEP, and sex and sport are known to potentially influence concussion reporting, these variables were included as covariates to account and control for the possible influences of these variables on the dependent variables. A conservative α level of .001 was adopted for all significance tests. A significant interaction suggests that the PCEP and control groups differed in their rate of change for that measure over time, and between-groups contrasts were then performed at each timepoint to determine differences in outcome. Mixed models were run for each measure separately with random intercepts for student-athlete, school, and division. For questions about experiences with concussion given only at the 1-month follow up (including questions about whether athletes reported their own or a teammate's concussion), logistic MLMs were used to account for nesting by division and school. For questions about concussion occurrence and reporting given only at follow up, logistic MLMs were used to account for nesting by division and school.

Athletic Trainer Qualitative Program Evaluation

At the end of the study, 8 athletic trainers participated in a program evaluation. All provided informed consent and then answered the following questions: (1) "What were your overall impressions of the implementation of the program, including what worked well and what didn't work?" (2) "How well did having peer educators providing the modules to their teammates work?" (3) "What suggestions do you have for improving the program?" The questions[25] were based on the Moutakas[26] recommendation to ask broad, general questions in qualitative research. Answers were then transcribed. We evaluated the entire set of answers blindly, without knowledge of the identity of the participant or school. Additionally, before analyzing the athletic trainer data, 2 researchers bracketed,[26,27] or set aside preconceived ideas that might influence their interpretation of previous knowledge or experiences that might influence their interpretation of the debriefing data. We then reviewed the transcripts of the debriefing responses several times to understand the overall phenomena of interest, which is an important component of an inductive approach to qualitative analysis.[27] Statements were coded to reflect the participants' experiences. Next, we independently developed clusters of meaning (themes) that organized these codes. Discrepancies were resolved through discussion to establish intercoder agreement.[27] Identification of themes stopped when saturation occurred (ie, the codes began to repeat),[27] which occurred in this dataset. Finally, the themes were arranged to describe the experiences of the participants during the PCEP implementation.[27]

[b] Random slopes for time were initially modelled at the levels of student-athlete, school, and division but were removed because they were near 0 (ie, the variation between student-athletes' and between schools' rates of change over time was near 0 for all measures).

RESULTS

Student-Athlete Data

Analysis-of-variance (ANOVA) tables summarizing the main effects, interactions, and covariates for each measure are presented in Table 4. Importantly, for all 10 outcome measures, time × condition produced significant effects, indicating that the PCEP participants changed more over time than the control participants. Time × condition effects were found for concussion knowledge ($F_{2,2648} = 51.3$, $P < .0001$), RTP protocol knowledge ($F_{2,2632} = 28.4$, $P < .0001$), and intention to report a suspected concussion in both oneself ($F_{2,2633} = 82.3$, $P < .0001$) and a teammate ($F_{2,2624} = 53.9$, $P < .0001$). Direct behaviors were also different across time between the PCEP and control conditions, including direct subjective norms for oneself ($F_{2,2625} = 51.7$, $P < .0001$) and teammates ($F_{2,2644} = 40.6$, $P < .001$) and direct perceived behavioral control for oneself ($F_{2,2628} = 53.7$, $P < .0001$) and teammates ($F_{2,2615} = 68.2$, $P < .0001$). In addition, indirect attitudes were different between groups across time when reported for oneself ($F_{2,2626} = 47.1$, $P < .0001$) and teammates ($F_{2,2623} = 40.9$, $P < .0001$). The means, standard deviations, and effect sizes across baseline, posttest, and 1-month follow up are presented for the knowledge measures (Table 5), intention to report (Table 6), direct measures (Table 7), and indirect perceived behavioral control (Table 8).

No differences occurred at baseline (ds = –0.10–0.04). On average, scores for student-athletes in either group were within 0.4% on any given measure. After the intervention, those who received the PCEP displayed an increase in each measure versus those who received the standard concussion training (ds = 0.18–0.41). Student-athletes who received the PCEP scored 10.5% higher on average for any given measure than student-athletes who did not receive the intervention. Gains in the experimental group relative to control persisted 1 month after the intervention (ds = 0.19–0.33). On any given measure, average scores for the student-athletes who received the PCEP remained 9.4% higher at the 1-month follow-up assessment compared with those of the average student-athlete who did not experience the intervention.

Effects of Sex and Sport. As sex and sport are known to influence concussion reporting,[2] they were included as covariates in the analysis. Sex was a significant covariate in concussion knowledge, RTP protocol knowledge, direct subjective norms for self, and indirect attitudes in oneself and one's teammates, with women consistently scoring higher at every timepoint than men on concussion knowledge and RTP protocol, direct perceived behavioral control (others' beliefs about reporting), direct subjective norms (feelings of being able to report a concussion), and direct perceived behavioral control (consequences of reporting).

Sport was a significant covariate for some analyses. On average, basketball players had less knowledge of concus-

Table 4. Analysis-of-Variance Table of Fixed and Covariate Effects for All Measures[a]

Measure	df_{den}	Covariate Sex ($df_{num} = 1$)	Covariate Sport ($df_{num} = 8$)	Repeated-Measures Time ($df_{num} = 2$)	Between-Subjects Effect Condition ($df_{num} = 1$)	Time × Condition ($df_{num} = 2$)
Concussion knowledge	2648	91.7[b]	5.0[b]	157.6[b]	54.8[b]	51.3[b]
Return-to-play protocol	2632	67.6[b]	3.1	25.0[b]	31.9[b]	28.4[b]
Intention to report						
Oneself	2633	0.2	1.6	278.9[b]	32.2[b]	82.3[b]
Teammates	2624	1.5	1.4	209.7[b]	44.7[b]	53.9[b]
Direct subjective norms						
Oneself	2625	24.5[b]	2.1	12.9[b]	19.2[b]	51.7[b]
Teammates	2644	1.7	1.6	20.2[b]	7.5[b]	40.6[b]
Direct perceived control						
Oneself	2628	11.0	1.5	100.8[b]	35.8[b]	53.7[b]
Teammates	2615	4.06	1.7	113.1[b]	46.9[b]	68.2[b]
Indirect attitudes						
Oneself	2626	72.9[b]	7.2[b]	30.9[b]	17.7[b]	47.1[b]
Teammates	2623	94.8[b]	6.7[b]	24.0[b]	25.7[b]	40.9[b]

Abbreviations: den, denominator; num, numerator.

[a] All values are *F* statistics with df as noted. Gender was a significant covariate for knowledge of concussion and return-to-play protocol, direct subjective norms (oneself), and indirect attitudes in oneself and teammates. Women consistently scored higher at every timepoint than did men on knowledge of concussion and return-to-play protocol as well as attitudes and subjective norms about concussion reporting, with small effect sizes (d range = 0.19–0.38). Sport was also a significant covariate for concussion knowledge and indirect attitudes for oneself and one's teammates. On average, basketball players (both men and women) had less knowledge at every timepoint of concussion symptoms than did players on other teams ($t_{2648} = 5.82$, $P < .001$, d = 0.20). Compared with other teams, on average, women's softball players endorsed less positive attitudes toward the intention to report for oneself ($t_{2626} = 5.23$, $P < .001$, d = 0.20) and others ($t_{2623} = 4.51$, $P < .001$, d = 0.18).

[b] $P < .001$.

sion symptoms (mean ± standard error = 20.17 ± 0.47) than did other teams (21.66 ± 0.44, $t_{2566} = 5.82$, $P < .0001$, d = 0.23) as did softball players (20.64 ± 0.50) compared with other teams (21.60 ± 0.44, $t_{2566} = 3.12$, $P < .002$, d = 0.11). At every timepoint, softball players also endorsed less direct perceived behavioral control for oneself (M = 34.84 ± 0.51) and ones' teammates (35.62 ± 0.62) than did student-athletes from other teams (for oneself: 37.35 ± 0.40, $t_{2547} = 4.54$, $P < .001$, d = 0.18; for others: 37.49 ± 0.45, $t_{2545} = 3.41$, $P < .002$, d = 0.14).

Effects of Previous Concussion Education. About one-third of student-athletes reported experiencing a previous concussions education program, which may have affected their knowledge and attitudes about concussion versus student-athletes who had never experienced concussion education. We reran all analyses controlling for an individual's history of concussion education. For each measure, the time × condition remained significant (all *P* values < .0001), suggesting that prior exposure to concussion-education programming did not influence student-athletes' potential for learning from the PCEP. Interestingly, main effects for prior concussion education were significant for concussion knowledge ($F_{2,2370} = 8.36$, $P < .0002$) and RTP protocol ($F_{2,2354} = 4.30$, $P < .01$) but not for any other measure (all *P* values > .50). At every timepoint, student-athletes with prior concussion education reported more concussion knowledge (22.09 ± 0.45) and RTP protocol knowledge (21.09 ± 0.33) than did those without prior education (for concussion knowledge: 21.37 ± 0.44; for RTP protocol knowledge: 20.78 ± 0.32) or those who did not know whether they experienced prior education (for concussion knowledge: 21.62 ± 0.47; for RTP protocol knowledge: 20.55 ± = 0.35).

Concussion Occurrence and Reporting at Follow Up. Both PCEP and control student-athletes reported on their experiences with concussion and reporting behavior in the month after the posttest. The ANOVA tables for these questions appear in Table 9. Versus control participants,

Table 5. Descriptive Statistics for Knowledge Comparing Peer Concussion Education Program (PCEP) With Control Condition Across Time[a]

Assessment	Condition or Effect Size	Baseline	Postintervention	1-mo Follow Up
Concussion knowledge	PCEP	20.25 ± 3.5	22.64 ± 3.7	21.82 ± 3.5
	Control	19.74 ± 4.2	20.44 ± 4.1	20.1 ± 3.9
	Effect size	0.07	0.41[b]	0.26[b]
Return-to-play protocol knowledge	PCEP	20.40 ± 2.8	21.23 ± 3.3	21.41 ± 3.2
	Control	20.30 ± 2.8	20.13 ± 3.1	20.26 ± 3.3
	Effect size	0.04	0.28[b]	0.24[b]

[a] Table values indicate mean ± SD and Cohen d effect size for each measure at baseline, postintervention, and 1-mo follow up. Positive d values indicate that the experimental group showed numerically greater scores than the control group at that timepoint.

[b] $P < .001$ indicates significant time × treatment effect.

Table 6. Descriptive Statistics for Intention to Report Comparing Peer Concussion Education Program (PCEP) and Control Conditions Across Time[a]

Assessment	Condition or Effect Size	Baseline	Postintervention	1-mo Follow Up
Intention to report self	PCEP	30.86 ± 8.7	36.32 ± 7.1	36.09 ± 7.1
	Control	31.31 ± 8.6	32.82 ± 8.3	33.30 ± 7.9
	Effect size	0.03	0.35[b]	0.26[b]
Intention to report teammate	PCEP	31.90 ± 8.3	36.66 ± 6.6	36.57 ± 6.8
	Control	31.60 ± 8.6	33.13 ± 8.1	33.47 ± 7.8
	Effect size	0.03	0.35[b]	0.30[b]

[a] Table values indicate mean ± SD and Cohen d effect size for each measure at baseline, postintervention, and 1-mo follow up. Positive d values indicate that the experimental group showed numerically greater scores than the control group at that timepoint.
[b] $P < .001$ indicates significant time × treatment effect.

student-athletes in the PCEP group were more likely to discuss concussion with a teammate ($F_{1,1396} = 13.96$, $P < .0001$), peer educator or knowledgeable teammate ($F_{1,1396} = 76.35$, $P < .00001$), coach ($F_{1,1396} = 4.09$, $P < .05$), and athletic trainer ($F_{1,1396} = 6.62$, $P < .001$). Compared with control participants, those receiving PCEP were nearly two-thirds more likely to discuss concussion with teammates (49.1% versus 38.5%, odds ratio [OR] = 1.61), 3 times more likely with peer educators (55.4% versus 28.9%, OR = 3.13), and about one-third more likely with coaches (37.2% versus 32.4, OR = 1.31) and athletic trainers (57.1% versus 48.1, OR = 1.36). The number of suspected concussions between those in the PCEP or control condition did not differ. Student-athletes were no more likely to suspect concussion in themselves (13.2% versus 16.8%, OR = 1.24) or others (15.9% versus 16.2%, OR = 1.05) whether they participated in the PCEP or not. However, when a teammate was suspected of having a concussion, those in the PCEP condition trended toward being more likely to report their teammate than those in the control condition ($F_{1,141} = 3.29$, $P < .10$). The rates of suspected and reported concussions in oneself and teammates are presented in Table 10. When student-athletes suspected concussion in teammates, PCEP participants were nearly 2.5 times more likely to report than were control participants (65.2% versus 54.7%, OR = 2.45). Reporting a suspected concussion in oneself was not different between PCEP and control student-athletes and was relatively high (74.4% versus 63.9%, OR = 1.61).

Athletic Trainer Debriefing Results

Responses from the 8 athletic trainers to the debriefing questionnaire yielded 56 significant statements that were organized into clusters of meaning resulting in 7 themes. The themes and exemplar statements are shown in Table 11.

Theme 1: Materials (Online Manual and Slides) Were Well Organized. Participants indicated that the online manual was helpful, clear, and well organized.

Theme 2: Clear Guidelines for Selecting PCEs. Participants stated that the online manual provided helpful information on the process and criteria for selecting the PCEs.

Theme 3: Worksheet Activity Was Engaging. Participants gave several statements indicating that Module 2 engaged the student-athletes. They also supported the rationale for not having staff present during this module.

Theme 4: Educational Material Was Challenging. The first education module presented by the PCEs to their teammates included information about the pathophysiology of concussion. Several participants indicated that it was difficult for some PCEs to understand and deliver this information, and some of their teammates appeared to "tune out" when it was being presented.

Theme 5: Scheduling Problems and Timing. Several participants indicated that scheduling the PCEP was difficult due to the demanding schedules of student-athletes.

Theme 6: Peers Were Better Than Authorities. Participants recognized the value of the peer-mediated aspect of the PCEP.

Table 7. Descriptive Statistics for Direct Behaviors Comparing PCEP (Peer Concussion Education Program) and Control Conditions Across Time[a]

Assessment	Condition or Effect Size	Baseline	Postintervention	1-mo Follow Up
Direct subjective norms: oneself	PCEP	24.96 ± 3.4	25.97 ± 3.2	26.16 ± 2.9
	Control	25.19 ± 3.4	24.9 ± 3.5	24.64 ± 4.0
	Effect size	−0.04	0.24[b]	0.23[b]
Direct subjective norms: one's teammates	PCEP	24.96 ± 3.4	25.97 ± 3.2	26.16 ± 2.9
	Control	25.19 ± 3.4	24.95 ± 3.5	24.46 ± 4.0
	Effect size	0.01	0.25[b]	0.26[b]
Direct perceived behavioral control: oneself	PCEP	29.49 ± 4.9	31.81 ± 4.4	32.03 ± 3.9
	Control	29.64 ± 5.0	29.93 ± 4.9	30.05 ± 5.2
	Effect size	−0.06	0.22[b]	0.27[b]
Direct perceived behavioral control: one's teammates	PCEP	28.83 ± 5.4	31.71 ± 4.5	31.88 ± 4.2
	Control	29.07 ± 5.7	29.38 ± 5.5	29.45 ± 5.7
	Effect size	*−0.10*	*0.18*[b]	*0.19*[b]

[a] Table values indicate mean ± SD and Cohen d effect size for each measure at baseline, postintervention, and 1-mo follow up. Positive d values indicate that the experimental group showed numerically greater scores than the control group at that timepoint.
[b] $P < .001$ indicates significant time × treatment effect.

Table 8. Descriptive Statistics for Indirect Behaviors Comparing Peer Concussion Education Program (PCEP) and Control Condition Across Time[a]

Assessment	Condition or Effect Size	Baseline	Postintervention	1-mo Follow Up
Indirect perceived behavioral control: oneself	PCEP	35.38 ± 6.7	37.83 ± 7.3	37.79 ± 7.4
	Control	35.51 ± 6.4	35.62 ± 6.9	35.13 ± 6.9
	Effect size	−0.01	0.31[b]	0.29[b]
Indirect perceived behavioral control: one's teammates	PCEP	35.68 ± 6.7	37.74 ± 7.4	38.00 ± 7.3
	Control	35.49 ± 6.7	37.74 ± 7.4	38.00 ± 7.3
	Effect size	−0.01	0.35[b]	0.33[b]

[a] Table values indicate mean ± SD and Cohen d effect size for each measure at baseline, postintervention, and 1-mo follow up. Positive d values indicate that the experimental group showed numerically greater scores than the control group at that timepoint.
[b] $P < .001$ indicates significant time × treatment effect.

Theme 7: Variation in PCEs' Abilities. Several participants commented on the presentation skills of the PCEs.

DISCUSSION

This multisite RCT evaluated the effectiveness of a peer-mediated, cognitive-behavioral PCEP to enhance concussion knowledge, attitudes, and behaviors supporting concussion reporting. Compared with standard concussion training, the PCEP had significant effects after implementation. Those teams receiving the PCEP showed increased knowledge of concussion symptoms and RTP protocols and more positive attitudes, subjective norms, and perceived control regarding concussion reporting. This is the first known study to show a peer intervention that influences changes in (1) concussion knowledge, (2) attitudes and intention to report for both oneself and teammates, and (3) discussions about concussions. Understanding factors such as reporting, perceived norms, and self-efficacy, in addition to knowledge, is important to increase program efficacy.[13]

Effect sizes were small but consistent across all measures and at 1-month follow up, which is not unusual for educational interventions with large sample sizes.[28,29] We purposely incorporated many key factors in the study design, creating a large, heterogeneous sample (as opposed to a carefully selected sample of participants who had not received concussion education or athletes from only 1 sport). All indicators changed significantly; the positive changes in many of the measures indicated that the PCEP can improve reporting behavior in collegiate athletes.

Socioecological Changes

The overarching goal of the PCEP was to positively influence concussion reporting among the student-athletes who participated, specifically in altering the attitudes and norms regarding and the willingness to discuss and report concussions of athletes. Kerr et al[20] suggested that the culture may change if behaviors and attitudes are addressed at multiple levels of the socioecological framework. The PCEP's peer-mediated and interdisciplinary approach, involving student-athletes, coaches, and athletic trainers, addressed not only intrapersonal (symptom and RTP protocol knowledge and attitudes) but also interpersonal aspects (attitudes and norms regarding teammates). Environmental changes were likely, as when the full team interacted in an exercise to change cognitions together. Moreover, the involvement of coaches and athletic trainers further reinforced the program's objectives at the environmental level.[20]

Collegiate athletes want more concussion education. Most (83.1%) indicated they would like more athletic community members involved and preferred lecture or video formats.[30] Our program was a 2-part interactive presentation delivered by 2 PCEs from among the student-athletes' teams. Meeting the needs of student-athletes for concussion education through a peer-centered model[18,19] appeared to change both knowledge and norms, especially

Table 9. Concussion Occurrence and Reporting

Reporting Behavior	df_{den}	Condition ($df_{num} = 1$)	Sex ($df_{num} = 1$)	Sport ($df_{num} = 8$)
Discussed with				
Teammates	1396	13.96[a]	8.29[b]	1.15
Peer educators or knowledgeable teammate	1396	76.35[c]	0.71	1.33
Coaches	1396	4.09[d]	2.14	0.62
Athletic trainers	1396	6.62[b]	0.07	1.19
Suspected concussion in				
Self	813	1.20	0.06	1.04
Teammate	822	0.06	0.08	1.78[e]
Reported suspected concussion in				
Self	164	2.24	0.07	0.18
Teammate	141	3.29[e]	2.43	1.03

Abbreviations: den, denominator; num, numerator.
[a] $P < .0001$.
[b] $P < .001$.
[c] $P < .00001$.
[d] $P < .01$.
[e] $P < .10$.

Table 10. Rates of Suspected and Reported Concussions in Oneself and One's Teammates[a]

Concussions	Group		
	Peer Concussion Education Program	Control	Total
Suspected			
Oneself	135	83	218
Teammates	115	95	210
Reported			
Oneself	129	98	227
Teammates	79	66	145

[a] Frequency of concussions suspected or reported by oneself and one's teammates.

for discussing reporting signs in teammates. Indeed, at 1-month follow up, PCEP participants were more than twice as likely to talk with peers and others about concussion and report when they suspected a concussion in a peer. Student-athletes in the PCEP discussed concussions more often with important others, including teammates, peer educators or knowledgeable teammates, coaches, and athletic trainers. This finding directly aligns with the research of Kroshus and Baugh[30] suggesting that student-athletes desired more involvement from coaches and that of Torres et al[31] indicating that student-athletes were likely to report to a teammate. With increased knowledge and expectations to report from teammates, peers are more likely to encourage teammates to seek medical attention.[32]

One unique aspect of the PCEP is that it addresses the safety of teammates as well as oneself. Increased intention to report a suspected concussion in a teammate, direct subjective norms (believing that others would be supportive of reporting a teammate's suspected concussion), direct perceived behavioral control (believing that one is able to report a teammate's suspected concussion), and indirect attitudes (consequences of reporting a suspected concussion) in a teammate were all increased in the PCEP group compared with the control group after the educational intervention. In addition, those in the PCEP group trended toward being more likely to report a suspected concussion in their teammate than those in the control condition. These results suggest that the PCEP has utility in influencing student-athletes' care for each other. The peer-mediated, educational approach influenced team norms and how teammates looked out for one another.

Changes in Concussion Knowledge

Most concussion-education programs aim to improve concussion knowledge.[10] Interestingly, concussion knowledge among student-athletes in this study was relatively high at baseline. Those who indicated prior exposure to concussion education showed more knowledge of concussion symptoms and RTP at every timepoint versus those who had never received such education, suggesting that trainings are effective. However, previous concussion education did not lead to differences between the PCEP and control conditions with respect to attitudes, norms, and the intention to report, indicating that the PCEP was novel in its effect on these important TRA or TPB constructs. Knowledge alone does not predict concussion-reporting behavior,[6,13,14] and additional educational programs such as the PCEP may be needed to influence attitudes and beliefs that are more directly related to behavior.

After the PCEP, student-athletes recognized an average of 2 additional symptoms of concussion compared with those in the control condition. Physical symptoms (eg, confusion, dizziness, headache) are more readily recognized than typically psychological and behavioral indicators (eg, irritability, emotionality, nervousness, sadness),[33] as they are more easily observable. The PCEP likely increased knowledge of these previously unrecognized symptoms: in a pilot study,[34] undergoing the PCEP resulted in the largest increases in knowledge of psychological symptoms, improving from less than 50% correct identification before the intervention to greater than 85% postintervention. In contrast, physical symptoms were well known to these pilot participants, identified at baseline by 90% or more.

Implementation Successes and Suggestions for Modification

Onsite athletic trainers implemented the program independent of the research team. Poststudy interviews with the athletic trainers revealed that the PCEP worked autonomously as designed. They found the online manual easy to navigate and felt they could use it without additional instruction. Athletic trainers liked the peer-education component, believing it promoted peer interaction regarding concussion and the cognitive-behavioral model of change and would likely be more effective than if an authority delivered the intervention. Helpful critiques were that time demands are always a concern for busy student-athletes and athletic staff, the scientific information needed to be more accessible to individuals at all levels, and selection of PCEs may need to be especially rigorous to ensure program quality.

Limitations

Our study did have several limitations. First, assessments occurred immediately after the intervention and 1 month later. A longer assessment timeframe consistent with the playing season would be desirable in future research. Second, not all sports were in season during the implementation of the intervention, possibly affecting responses on the outcome measures. Student-athletes may have found the intervention more salient when in season. Despite deliberate sampling procedures and recruitment attempts, no schools from the West regions agreed to participate, and no institutions with enrollment over 11 000 participated. The results may not generalize to institutions from the unrepresented geographic regions or to those with very large enrollments. Finally, athletic staff contacted through random sampling had to choose to participate. Staff from schools with a strong interest in concussion education may have been more likely to participate than those at schools with less commitment, which may have resulted in preexisting cultures supportive of or negative toward concussion reporting. The athletic trainers indicated that, although the information in the education modules was clear, some PCEs had difficulty presenting some of the more complex material, including information on the pathophysiology of concussion.

Table 11. Athletic Trainer Debriefing and Program Evaluation Themes

Theme	Exemplar Statement(s)
Materials (online manual and slides) were well organized	". . . having everything laid out and, you know, here's the directions, and here is what needs to be done, and everything is laid out step by step was great. It left no room for doing it on your own, if you will, and I think that worked well as well."
	"The PowerPoint [slide] presentations were helpful to use and put together professionally."
Clear guidelines for selecting PCEs	"I think the other thing that was helpful was having the basic characteristics you would want in your peer educators. You know, when I started to reach out to my coaches about selecting peer educators and working together, our head coach was like, 'Why don't you use the seniors?'" and it was like we were explaining that you do not necessarily want to do that, and we want people that will be ingrained in the team for a couple of years."
	"I would say what worked well was having a knowledge base of what student-athletes we were going to pick as the peer educators. Obviously, athletic trainers like myself are going to have a good relationship with the student-athletes and asking the coaches along with our administrators who we thought, we kind of collaborated together honestly, and that worked pretty well. We all thought about the same people when it came to who would be a peer educator, so that worked really well."
Worksheet activity was engaging	"I think the kids did like the activities in the second PowerPoint [slide presentation]. I was not in there, but I was nearby in a different office, but I did hear them laughing, and I think they made it their own, and I liked that part of it where I was removed for the second half, and they kind of led it themselves, had their own experiences with it, and really made it their own, so I really liked that part of it, and the kids really bought into it."
	"The exercise to change your thought process on barriers to report concussion was very beneficial."
	"I know that, when we stepped away after we talked about the second portion of the program and we step out and they do their cognitive-behavioral stuff, I think they respond pretty well, and they were pretty open to what they were talking about in there, and I think it was a great program."
Educational material was challenging	". . . too much science on concussions during the presentation. Our biology majors where [were] fine, but some of our peer educators and a lot of our students tuned out during that point of the presentation. The peer educators also thinned out that section and moved through it quick. It felt like they weren't comfortable going over that information, so moved fast."
	". . . less on the science of concussions."
	"Some individuals got it, and others were like, 'This is a lot of science knowledge,' so it was hard for those that do not have that science base."
Scheduling problems and timing	". . . the most difficult piece for me was the team meetings and getting all of the athletes together at a certain time during a very hectic time of year as their classes began to wrap up as well. That was most likely the most difficult piece for me. Since the majority of the sports were nonin-season, the meetings were not able to be labeled as 'mandatory.'"
	"For our institution, it was difficult to start the program in the middle of the year, as all of our teams are in full swing, and the amount of free time to work with the student-athletes around their extremely busy schedules was difficult. I think if we could have started the program at the beginning of the fall semester, it would have went [sic] better, and we would have had more compliance for all teams involved."
	"For our institution, I think this would be a great program to use during the summer when some of our teams are here for their summer strength and conditioning programs."
Peers were better than authorities	"I liked it because it was not me continuing to drone on about concussion risk and what can happen and what the signs and symptoms look like. I think it was better received by the student-athletes coming from one of their own peers."
	"I think they were more inclined to listen because it was something that their coaches were not speaking, and it was not just another team meeting, and despite the relationship we have with our teams, we talk with them about different things, and we educate them about different things, and we go over our concussion protocol in the team meeting at the beginning of every academic year, and what I learned after this is that they don't listen as well. They look like they are, but having peer educators do this, sitting in the back of the room [participant refers to herself], they were all alert, attentive, and the team was engaged a little bit more, and they were saying, you know, 'Great job teaching this.' So it was a neat little team-building moment."
Variation in PCEs' abilities	"[S]ome were honestly better presenters and had more of natural ability to lead their groups than others."
	"[I]t worked well for the peer educators because they picked up a lot of information, but they still struggled to keep the attention of their teammates."

Abbreviation: PCE, peer concussion educator.

CONCLUSIONS

Participation in the novel PCEP increased concussion knowledge and understanding of key aspects of RTPs in collegiate student-athletes. In addition, participation in the PCEP increased the intention to report concussion and improved attitudes, subjective norms, and beliefs about behavioral control to report for both oneself and one's teammates. These changes were observed for all study measures and remained at 1-month follow up, suggesting that the program holds promise for changing attitudes and norms that can potentially enhance concussion reporting. The use of a peer-mediated approach is further supported by our finding that the student-athletes appeared to be more receptive when information was provided by a peer as opposed to staff. In addition, feedback from the athletic trainers who implemented the program indicated that it was consistent with the original interdisciplinary, peer-mediated, cognitive-behavioral model. The athletic trainers also found the online manual to be clear and easy to use and the PCEP easy to implement, autonomously supporting its potential for widespread dissemination.

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