Concussion Education in the School Setting: A Scoping Review

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ABSTRACT

BACKGROUND: Concussions are a prevalent injury among youth, and concussion education has the potential to promote positive concussion-related behaviors. Recent recommendations and legislation have increased concussion education provided in schools; however, little is known about the education context, delivery method, development, and evaluation. A scoping review was conducted to identify peer-reviewed literature on concussion education delivered in the school setting.

METHODS: Six databases were searched (MEDLINE, CINAHL, EMBASE, PsycINFO, SPORTDiscus, and ERIC) to identify published articles from 2002 to July 16, 2020 that delivered concussion education in the school setting. Included studies described the concussion education and were written in English.

RESULTS: A total of 11,373 articles were identified and screened, with 27 studies meeting eligibility criteria and therefore, included. The studies delivered education to various stakeholders including students (n = 12; 44.4%), coaches (n = 5; 18.5%), educators (n = 3; 11.1%), parents (n = 1; 3.7%), and a mixed audience (n = 6; 22.2%). The education format varied and six studies (22.2%) developed the education based on a theory, model, or framework.

CONCLUSIONS: This study found substantial variability in the context, delivery method, development, and evaluation of education delivered in schools and further evaluation of this education is needed to ensure it is best-suited for school-based stakeholders.

Keywords: concussion; education; school-based interventions; mild traumatic brain injury.

Citation: Mallory KD, Saly L, Hickling A, Colquhoun H, Kroshus E, Reed N. Concussion education in the school setting: a scoping review. J Sch Health. 2022; 92: 605-618. DOI: 10.1111/josh.13156

Received on August 21, 2021
Accepted on February 15, 2022

A concussion, also known as mild traumatic brain injury (mTBI), is caused by a blow, force or jolt to the head, face, neck, or body.\textsuperscript{1} Approximately 33 million children and youth worldwide experience a concussion annually,\textsuperscript{2} with the greatest number of concussions occurring among youth in their adolescent years.\textsuperscript{3,4} Individuals with a concussion can experience a range of symptoms including headaches, cognitive challenges, difficulty managing emotions, and sleep disturbances.\textsuperscript{1} Among children and youth, concussions

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This work was funded by the Canadian Institutes of Health Research (#153025). We would like to acknowledge the efforts of the members of the “Youth Concussion Awareness Network” (You-CAN) team, the Bloorview Research Institute and the OAK Concussion Lab. We would also like to thank librarians Erica Nekolaichuk and Mikaela Gray from the University of Toronto and Pu-Ying Wong from Holland Bloorview Kids Rehabilitation Hospital for their assistance with developing a search strategy and completing comprehensive database searches.
can result from a range of causes, such as sports, recreational play, falls, motor vehicle collisions, and assault.\(^5\)

Approximately 30% of children and youth with a concussion will experience persistent concussion symptoms, meaning that it takes longer than the typical 4 weeks for their symptoms to resolve.\(^5\) Specifically, youth are more likely to experience a longer recovery time compared to younger children\(^2\) and adults.\(^2\) In addition to experiencing higher concussion rates and longer recovery times, youth take longer to return to school and sports after a concussion and are more likely to have a greater number of symptoms than younger children.\(^2\)

Youth have been reported to lack concussion knowledge\(^6,7\) and concussion education has been suggested as one way to mitigate this.\(^1\) In addition to enhancing concussion knowledge, concussion education has the potential to promote positive behaviors surrounding concussion among youth such as increasing the likelihood of reporting a concussion to an adult.\(^8,9\) Education of individuals who interact with youth such as their parents,\(^10\) coaches,\(^11\) and teachers,\(^12\) may also positively impact youths’ concussion-related behaviors. For example, emphasis has been placed on providing concussion education to parents as they can play a pivotal role in concussion education and management prior to a concussion, immediately after a concussion and throughout the recovery process.\(^10\)

The most recent International Consensus Statement on Concussion in Sport has recommended that schools implement concussion policies that include education for teachers, staff, students, and parents about concussion as well as provide strategies for accommodations and support within the school setting.\(^1\) The Ministry of Education in Ontario, Canada has implemented the Program/Policy Memorandum (PPM) 158: School Board Policies on Concussion.\(^13\) PPM 158 outlines guidelines for school boards mandating a concussion safety policy that recommends review of concussion resources and training for relevant school staff on topics such as removal from play and return to school strategies.\(^13\)

Despite recommendations for concussion education within the school setting, to date, the focus of most concussion education has been on athletes and sport-related concussions, even though only 30% of concussions in youth occur during sports.\(^3\) There is a need for concussion education developed specifically for the school setting as experiencing a concussion can impact children and youths’ ability to engage in school activities. Students with a concussion reported symptoms while attending school and disruptions to their academic skills.\(^14\) High school students with a concussion also had a lower grade average than those without a concussion.\(^15\)

In addition to the focus of education on athletes and sport-related concussion, current education has been delivered across ages\(^16,17\) and varied based on the content included.\(^1\) A past review found that all included studies delivered concussion education at one-time point and consisted of interactive oral presentations, educational videos, and computer-based learning programs.\(^16\) Despite this, little is known about the development and evaluation of current concussion education. Although there have been recommendations to develop and evaluate concussion education using knowledge translation models and frameworks,\(^1,18\) there is minimal information available on how these are implemented. As well, among existing studies that deliver and evaluate concussion education, few evaluate the long-term retention of outcomes.\(^16\)

Although there is an emphasis and need for educating youth and those that interact with them about concussion, not all concussion education results in enhanced knowledge and positive concussion-related behaviors. For example, one study found that high school athletes with previous concussion education had increased concussion knowledge; however, this increased concussion knowledge did not result in more favorable self-reporting behaviors.\(^7\) Another study found that among 10- and 14-year-old hockey players, viewing an educational video resulted in immediate increases in concussion knowledge, however at 2 months, the increases in knowledge were not sustained, nor did they result in positive changes to concussion attitudes or behaviors.\(^19\) Concussion education has the potential to enhance concussion knowledge and promote positive concussion-related behaviors, however, the relationship between concussion education and positive behavior change is not yet fully understood.

If well designed, implemented, and evaluated, concussion education delivered in the school setting has the potential to reach a broad audience and may lead to a more supportive environment as youth return to school following a concussion. As previous reviews on concussion education have primarily focused on content delivered to athletes,\(^16,17\) concussion education provided in school settings has been largely unexplored. Therefore, the purpose of this scoping review was to identify the context, delivery method, development, and evaluation of concussion education delivered in the school setting.

**METHODS**

This scoping review followed the methodological framework described by Arksey and O’Malley\(^20\) and the adaptations summarized by Levac et al.\(^21\) as well as the reporting guidance outlined by the Preferred Reporting Items for Systematic reviews and Meta-
Analyses extension for Scoping Reviews (PRISMA-ScR). The following steps were taken to conduct this scoping review.

Identifying the Research Question

This scoping review was conducted to answer the research question: What existing peer-reviewed literature on concussion education is delivered in the school setting? Specifically, the authors wanted to explore and summarize the concussion education (1) context, (2) delivery method, (3) development, and (4) evaluation.

Identifying Relevant Studies

To identify relevant studies, six databases, including MEDLINE, CINAHL, EMBASE, PsycINFO, SPORTDiscus, and ERIC, were searched until July 16, 2020. The search strategy was developed and conducted by the first author (KM) in consultation with academic health science librarians. All databases were searched using a combination of subject headings and keywords (see Table 1 for the MEDLINE search strategy). The reference lists of included studies were searched by the first author (KM) to identify any additional relevant studies that were not identified through the database searches.

Study Selection

After identifying relevant studies, duplicates were removed using EndNote and Covidence. Prior to full title and abstract screening, a pilot of 100 articles were independently screened by the first author (KM) and both the second and third authors (LS, AH). During the piloting process, conflicts, and questions regarding eligibility criteria were discussed prior to title and abstract screening with any resulting clarity improvements documented. The remaining title and abstract screening, and full-text screening were completed independently by the first author (KM) and either the second (LS) or third author (AH). After the completion of each level of screening, the authors discussed conflicts with discrepancies resolved by the senior responsible investigator (NR).

In order to be eligible for inclusion in this scoping review, the study had to implement concussion education in the school setting, which included kindergarten, elementary, middle, or high school. For the purposes of this study, concussion education was defined as sharing information with others with an explicit focus or mention of concussion. Relevant studies also had to provide a description of the concussion education. Lastly, studies had to be primary research that was written in English. Articles were excluded if they focused on a one-to-one treatment model (eg, providing concussion education or care to an individual) to exclude studies focused on personalized concussion care or management. Articles were also excluded if they were conference abstracts, theses, protocol papers, or white papers. Articles published prior to February 2002 were excluded to ensure that all studies were published after the publication of the first International Conference on Concussion in Sport, a consensus meeting used by experts in the field of concussion to inform practice recommendations, including concussion education. Only articles published after the publication of the first International Conference on Concussion in Sport were eligible for inclusion to ensure that international guidelines were available to guide the inclusion of key components and considerations for concussion education and management.

Charting the Data

A data extraction tool was developed by the first author (KM) in collaboration with the second and third authors (LS, AH). These three authors independently completed a pilot extraction with five randomly selected studies to ensure clarity of the tool. All study extraction was completed independently by the first author (KM) and either the second (LS) or third author (AH). After study extraction was completed, the first three authors (KM, LS, AH) reviewed the data and discussed conflicts with discrepancies resolved by the senior responsible investigator (NR).

Data were extracted on study characteristics (ie, authors, title, year of publication, country of study, name of journal, study purpose, and study design as described in the study), education context (ie, target audience, number of participants, name, and objective of the education, type of school, concussion topics addressed, and any additional education topics addressed), education delivery method (ie, who delivered the education, how the education was delivered, length of the education, number of sessions, and delivery modality), education development (ie, the development process and if the concussion education

Table 1. MEDLINE search strategy

| School Term | Concussion Term |
|-------------|-----------------|
| 1. Schools/ | 12. Brain Concussion/ |
| 2. school*.tw,kf | 13. concuss*.tw,kf |
| 3. School Teachers/ | 14. Post-Concussion Syndrome/ |
| 4. teacher*.tw,kf | 15. postconcuss*.tw,kf |
| 5. Students/ | 16. Brain Injuries, Traumatic/ |
| 6. student*.tw,kf | 17. mtbi*.tw,kf |
| 7. classroom*.tw,kf | 18. (traumatic adj3 brain injur*).tw,kf |
| 8. school principal*.tw,kf | 19. 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 |
| 9. Educational Personnel/ | 20. 11 AND 19 |
| 10. educator*.tw,kf | |
| 11. 1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 |
was developed based on any theories, models or frameworks, or referenced existing resources) and lastly, the education evaluation (ie, if the education was evaluated, the evaluation method(s) used, outcomes captured by the evaluation method(s), if the evaluation was based on any theories or models, and when the evaluation occurred). As there are currently no standards for required topics/components to include in concussion education, for this review, concussion topics were categorized based on recommendations made by Russell et al.26

Collating, Summarizing, and Reporting the Results

Data charted from the studies was summarized using descriptive statistics (frequencies and percentages) and grouped based on the extraction categories (ie, study characteristics, and education context, delivery method, development, and evaluation).

RESULTS

A total of 11,373 articles were identified through the database searches, with 5177 duplicates removed and 6196 articles screened for title and abstract. Among these, 169 were assessed for full-text eligibility, with 142 excluded. No additional relevant studies were identified through searching the reference lists of included studies. A total of 27 studies were included. See Figure 1 for the PRISMA flow diagram.

Study Characteristics

The majority of studies were conducted in the United States (n = 23; 85.2%),27-49 with two conducted in Canada (7.4%)50,51 and one in both Ireland (3.7%)52 and Australia (3.7%).53 The studies were published in 25 different peer-reviewed journals, with two published in the Clinical Journal of Sport Medicine29,30 and two published in the Orthopedic
The studies described the use of various study designs including prospective cohort (n = 4; 14.8%), cross-sectional (n = 3; 11.1%), pre-post (n = 3; 11.1%), post-only (n = 2; 7.4%), randomized control trial (n = 2; 7.4%), case study (n = 1; 3.7%), crossover (n = 1; 3.7%), intervention (n = 1; 3.7%), quasi-experimental (n = 1; 3.7%), and pilot (n = 1; 3.7%). In addition, 7 studies (25.9%) did not describe the study design used. See Table 2 for additional details on the included studies.

**Education Context**

Concussion education was delivered to various audiences within the school setting. When delivered to one specific audience, the education was delivered to students (n = 12; 44.4%), coaches (n = 5; 18.5%), educators (n = 3; 11.1%), or parents (n = 1; 3.7%). Six studies (22.2%) were delivered to a mixed audience which included some combination of students, coaches, educators, parents, and healthcare professionals. Among education delivered to students, coaches, educators, parents, and healthcare professionals (n = 1; 3.7%), 13 studies (48.1%) described concussion education delivered to only athletes. Six studies (22.2%) followed by middle school (n = 2; 7.4%) and elementary/primary school (n = 1; 3.7%). Three studies (11.1%) were provided to a mixed-age group and four studies (14.8%) did not describe the age or grade of the sample. About half of the studies (n = 13; 48.1%) described concussion education that used a formal name for the education delivered (eg, Sports Legacy Institute Community Educators [SLICE]).

The most commonly addressed concussion topic was concussion signs and symptoms, which was discussed in 17 studies (63.0%). The second most commonly addressed topic was medical management of a concussion, which was addressed in 15 studies (55.6%). Return to school (managing a concussion in the school setting) was discussed in 10 studies (37.0%). See Table 3 for a full list of the concussion topics addressed.

**Education Delivery Method**

The majority of studies included in this review were delivered in-person (n = 15; 55.6%). Other methods of delivery included self-directed online modules (no instructor present; n = 4; 14.8%), supported online modules (instructor present; n = 2; 7.4%), mailed (n = 2; 7.4%), not specified (n = 1; 3.7%) and other (n = 3; 11.1%). Many studies (n = 12; 44.4%) involved the presence of, or delivery by, a member of the research team. As opposed to being self-directed (n = 7; 25.9%), or were delivered by another individual (eg, student healthcare professionals) (n = 4; 14.8%). Four studies (14.8%) provided no details on who delivered the education.

The primary format of the education included a presentation (n = 12; 44.4%), video (n = 1; 3.7%), combination of a presentation and a video (n = 1; 3.7%), active learning activity (n = 1; 3.7%), interactive arts-based component (n = 1; 3.7%) and unspecified format (n = 1; 3.7%). The majority of studies (n = 21; 77.8%) described facilitation techniques used to enhance the education, such as opportunities to ask questions, group discussions, reflection periods, quizzes, demonstrations, and discussion of shared experiences. The length of the education varied from 9 minutes to components delivered over 2 weeks. The most common length of education (n = 12; 44.4%) was between 20 and 60 minutes.

**Education Development**

The majority of studies (n = 25; 92.6%) provided some description of the education development. Among the 27 studies, six (22.2%) were explicit about the use of a theory, model or framework in the development process. The six theories, models, and frameworks were distinct and included the knowledge to action cycle; health belief model; science, technology, engineering, arts and mathematics (STEAM) curriculum; diffusion of innovation theory; theory of planned behavior; and active learning principles.

Education developed by referencing existing concussion resources (eg, International Consensus Statements on Concussion in Sport) was also explored. Nineteen studies (70.4%) referenced existing resources with the most commonly referenced resources created by the Centers for Disease Control and Prevention (CDC; n = 9; 33.3%), the International Consensus Statements on Concussion in Sport (n = 6; 22.2%) and published journal articles on concussion (n = 6; 22.2%).
| Author(s) (Year) | Formal Name of the Concussion Education | Target Audience | Education Format and Length | Development Based on a Theory, Model or Framework | Evaluation Methods and Outcomes Captured |
|----------------|----------------------------------------|----------------|-----------------------------|-----------------------------------------------|---------------------------------------|
| Bagley et al. (2012)27 | Sports Legacy Institute Community Educators (SLICE) | Elementary, middle, and high school students | 40-60 minute presentation | Not described | Quiz: Demographic information, concussion knowledge with an emphasis on signs and symptoms and appropriate responses after a concussion |
| Caron et al. (2017)30 | Not included | High school students | Four, 30 minute presentations | Knowledge to action cycle64 | Rosenbaum Concussion Knowledge and Attitudes Survey-Student Version (RoCKAS-ST): Concussion knowledge and attitudes61 Qualitative data: Description of participants knowledge, attitudes, and perceptions/experiences of the intervention |
| Carzoo et al. (2015)28 | Not included | Middle and high school coaches and educators | 30 minute presentation | Not described | Demographic questionnaire: Demographic information Study questionnaire: Mechanism of injury, common concussion knowledge and myths, signs, and symptoms, activities that tend to worsen symptoms, when to attend school with symptoms, signs that coursework may be becoming more difficult for a student, and appropriate academic accommodations for a student complaining of symptoms |
| Case et al. (2017)53 | Not included | Elementary school educators | 90-120 minute presentation | Not described | Teacher background questionnaire: Teacher and school demographics Knowledge assessment scale: mTBI knowledge Workshop evaluation form: Satisfaction, perceived usefulness, relevance, novelty of content, and likelihood of implementation Test: Background questions (individual and school demographics), concussion awareness, knowledge, and confidence in concussion response and prevention |
| Davies and Tedesco (2018)29 | Ohio Return to Learn Concussion Team Model or Teacher Training, Ohio Return to Learn Concussion Team Model | Coaches, educators, and healthcare professionals | Ohio Return to Learn Concussion Team Model: 75-minute online module Teacher Training, Ohio Return to Learn Concussion Team Model: 30 minute online module | Not described | Questionnaire: Concussion signs and symptoms, concussion assessment, accommodations for students with a concussion, and scenarios involving concussions Number of concussion cases Types of services provided: Student needs and accommodations Stakeholder feedback |
| Davies, Sandlund, and Lopez (2016)30 | Not included | Coaches, educators, and healthcare professionals | 1 hour presentation | Not described | |
| Author(s) (Year)       | Formal Name of the Concussion Education | Target Audience                                                                 | Education Format and Length          | Development Based on a Theory, Model or Framework | Evaluation Methods and Outcomes Captured                                                                 |
|-----------------------|-----------------------------------------|---------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Echlin et al. (2014)  | Not included                            | High school students                                                           | 40 minute e-module                   | Not described                                    | Test: Concussion knowledge, signs and symptoms, possible treatment options, suggested postconcussion practice, and return-to-play guidelines |
|                      |                                         |                                                                                 |                                      |                                                  | Sports demographic survey Test: Knowledge of concussion, definition, signs and symptoms, basic skull and brain anatomy, safety measures, and how to respond in the event of a head injury Athlete survey: Knowledge, knowledge application, and intention to report a concussion Parent survey: Knowledge, knowledge application, and behavioral intention toward responding to a sports concussion situation Concussion logs: Injury, number of days until return to full activity, concussion symptoms, whether the student saw a health care professional for injury evaluation/treatment, if the athlete returned to full activity and if not, why, and whether the athlete received classroom accommodations and if so, what type (recorded by the athletic therapist) Exit interview with administrators: Inquired about concussion management policies and procedures Traumatic brain injury (TBI) knowledge: Knowledge of effective strategies for working with students with TBI within the school TBI knowledge application: Determining the effectiveness of a teacher responding to a classroom situation with a student with TBI Self-efficacy: Applied and general self-efficacy Program satisfaction: Program usability and satisfaction                              |
| Elliott et al. (2016) | Head Safety in Youth Sports (HSYS) Program | Middle school students                                                          | 35-45 minute presentation            | Not described                                    | Test: Knowledge of concussion, definition, signs and symptoms, basic skull and brain anatomy, safety measures, and how to respond in the event of a head injury Athlete survey: Knowledge, knowledge application, and intention to report a concussion Parent survey: Knowledge, knowledge application, and behavioral intention toward responding to a sports concussion situation Concussion logs: Injury, number of days until return to full activity, concussion symptoms, whether the student saw a health care professional for injury evaluation/treatment, if the athlete returned to full activity and if not, why, and whether the athlete received classroom accommodations and if so, what type (recorded by the athletic therapist) Exit interview with administrators: Inquired about concussion management policies and procedures Traumatic brain injury (TBI) knowledge: Knowledge of effective strategies for working with students with TBI within the school TBI knowledge application: Determining the effectiveness of a teacher responding to a classroom situation with a student with TBI Self-efficacy: Applied and general self-efficacy Program satisfaction: Program usability and satisfaction                              |
| Glang et al. (2015)   | Brain 101: The Concussion Playbook       | High school coaches, educators, healthcare professionals, parents, and students | Online module                       | Health belief model                              |                                                                                                     |
| Glang et al. (2018)   | In the Classroom after Concussion: Best Practices for Student Success | Educators                                                                       | Online module                       | Not described                                    |                                                                                                     |
| Graff and Caperell (2016) | Not included                        | High school educators                                                          | 20 minute presentation               | Not described                                    |                                                                                                     |
| Hunt (2015)           | Not included                           | High school students                                                            | 9 minute video                      | Not described                                    |                                                                                                     |
| Author(s) (Year)                        | Formal Name of the Concussion Education | Target Audience                      | Education Format and Length                        | Development Based on a Theory, Model or Framework | Evaluation Methods and Outcomes Captured |
|----------------------------------------|-----------------------------------------|---------------------------------------|---------------------------------------------------|-------------------------------------------------|------------------------------------------|
| Kerr et al. (2016)36                   | Heads Up Football Program               | High school coaches                   | Online module                                      | Not described                                    | Injury and exposure information         |
| Kurowski et al. (2015)37               | Not included                            | High school students                  | 20 minute presentation                             | Not described                                    | Questionnaire: Demographics, concussion knowledge and attitudes/behaviors about willingness to report or stop activity after sustaining a concussion and other injuries during play |
|                                        |                                         |                                       |                                                   |                                                 | End-of-the-season questionnaire: Concussion reporting behaviors |
|                                        |                                         |                                       |                                                   |                                                 | Demographic Survey Instrument (DSI)          |
|                                        |                                         |                                       |                                                   |                                                 | Educational Intervention Post Survey (EIPS): Participants’ perception, knowledge and awareness of concussions, attitudes toward sports-related concussions, and information-seeking behavior related to concussions |
|                                        |                                         |                                       |                                                   |                                                 | Prior to training: Self-rating of perceived concussion knowledge and knowledge assessment |
|                                        |                                         |                                       |                                                   |                                                 | Immediately following training: Training satisfaction, ranking the importance of the 10 competencies, and knowledge assessment |
|                                        |                                         |                                       |                                                   |                                                 | Follow-up to training: Competency relevance ranking and training satisfaction |
|                                        |                                         |                                       |                                                   |                                                 | Rosenbaum Concussion Knowledge and Attitudes Survey-Student Version (RoCKAS-ST): Concussion knowledge, concussion attitudes, and validity scale |
|                                        |                                         |                                       |                                                   |                                                 | TBI knowledge: Knowledge of effective strategies for working with students with TBI in school |
|                                        |                                         |                                       |                                                   |                                                 | TBI knowledge application: Responding to situations with a student who has TBI |
|                                        |                                         |                                       |                                                   |                                                 | Self-efficacy: Confidence in responding to situations with a student who has a TBI |
|                                        |                                         |                                       |                                                   |                                                 | Program satisfaction: Program usability and satisfaction |
| Macdonald and Hauber (2016)38          | Not included                            | High school parents                   | 30-40 minute online module                         | Not described                                    |                                          |
| Maerlender et al. (2019)39             | Not included                            | Kindergarten-grade 12 educators and healthcare professionals | 4-5 hour presentation                             | Not described                                    |                                          |
| Manasse-Cohick and Shapley (2014)60    | Not included                            | High school students                  | 5 minute video and 20 minute presentation          | Not described                                    |                                          |
| McCart et al. (2020)41                 | In the Classroom after Concussion: Best Practices for Student Success | Educators and healthcare professionals | 21 modules (15 minutes per module)                 | Not described                                    |                                          |
| Author(s) (Year)                       | Formal Name of the Concussion Education                                                                 | Target Audience          | Education Format and Length                                                                 | Development Based on a Theory, Model or Framework                                                                 | Evaluation Methods and Outcomes Captured |
|---------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Minen and Boubour (2018)              | The Headache and Arts Program                                                                           | High school students     | 2 weeks of interactive arts-based classes                                                    | Science, technology, engineering, arts and mathematics (STEAM) curriculum                                      | Qualitative: Artwork depicting the experience of a migraine or concussion and a paragraph about students’ knowledge transfer project |
| Mitchko et al. (2007)                 | Centers for Disease Control and Prevention’s Heads Up: Concussion in High School Sports                  | High school coaches      | Toolkit                                                                                      | Not described                                                                                                   | Tool kit and material: Coaches’ appraisal, perception, intent to use, and actual use                                |
| Miyashita et al. (2014)               | Not included                                                                                              | High school students     | 25 minute presentation                                                                       | Not described                                                                                                   | Concussion history                       |
| Sarmento et al. (2010)                | Centers for Disease Control and Prevention’s Heads Up: Concussion in High School Sports                  | High school coaches      | Toolkit                                                                                      | Not described                                                                                                   | Survey: Coaches use of the toolkit, concussion knowledge, attitudes, and behaviors toward concussion prevention |
| Sawyer et al. (2010)                  | Centers for Disease Control and Prevention’s Heads Up: Concussion in High School Sports                  | High school coaches      | Toolkit                                                                                      | Diffusion of innovation theory                                                                                   | Focus groups: To provide insight on quantitative findings                                                      |
| Shanley et al. (2019)                 | US Football Heads Up Program                                                                            | High school coaches      | Not described                                                                               | Not described                                                                                                   | Computer-assisted telephone survey: Demographics of school coaches, school contextual variables, initial attention by coaches to toolkit materials, coaches’ use of or plans to use toolkit materials, and coaches’ assessment of the toolkit |
| Stead et al. (2019)                   | Not included                                                                                              | Middle school students   | 45 minute presentation                                                                       | Not described                                                                                                   | Injury surveillance: Participation in practice and availability for games, and the occurrence of a sport-related concussion throughout the 2015-2016 competitive football season |
| Sullivan et al. (2018)                | Not included                                                                                              | High school students     | 60 minute presentation                                                                       | Theory of planned behavior                                                                                     | Fidelity control rubrics: Implementation and adherence to Heads Up program                                         |
| Wallace et al. (2019)                 | Concussion Bingo                                                                                          | High school students     | 30 minute active learning activity                                                             | Active learning principles                                                                                        | Questionnaire: Background information, knowledge, attitudes toward the perceived outcomes of concussion reporting, subjective reporting norms, perceived behavioral control, and reporting intention (with respect to sport-related concussion) |

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Concussion Education Topic | Studies Addressing Concussion Education Topic, n (% of studies)
---|---
Signs and symptoms | 17 (63.0)
Medical management | 15 (55.6)
Definition | 12 (44.4)
Return to school | 10 (37.0)
Long-term effects | 9 (33.3)
Prevention | 9 (33.3)
Epidemiology | 8 (28.6)
Return to sport | 8 (28.6)
Mechanism of injury | 7 (25.9)
Identification of a suspected concussion | 6 (22.2)
Risk factors | 6 (22.2)
Reporting/underreporting | 4 (14.8)
Other | 11 (40.7)

**Education Evaluation**

All studies provided some type of education evaluation. Most studies (n = 14; 51.9%) used evaluation methods that were newly designed by the research team specifically for the education delivered. Alternatively, 5 studies (18.5%) modified previously used evaluation methods, 2 studies (7.4%) used previously developed evaluation tools, and 6 studies (22.2%) used a combination of previously used, modified, or specifically designed evaluation methods. To learn more about the specific evaluation methods and outcomes captured, see Table 2.

**Use of theory or model.** Of the evaluation methods used, two studies (7.4%) were explicit about basing the evaluation methods on a theory or model. These included one survey which was based on the social cognitive theory, health belief model and theory of reasoned action, and another on the theory of planned behavior. Both studies used surveys that had been developed for previous work based on the above theories and model.

**Evaluation timing.** The specific timing of the evaluation was captured for most studies (n = 25, 92.6%), where nearly half of the studies (n = 13; 48.1%) had participants complete a pre-test prior to the education and a single post-test immediately after the education. Of these studies evaluating outcomes at more than one-time point post-education, only eight studies (29.6%) included longer-term evaluation that assessed retention, with these studies evaluating outcomes at more than one-time point post-education. The longest evaluation time point occurred 5 months after the concussion education.

**DISCUSSION**

Overall, the purpose of this scoping review was to identify existing studies published in peer-reviewed journals on concussion education that was delivered in the school setting. More specifically, the authors were interested in the study characteristics, and the education context, delivery method, development, and evaluation. The concussion education described varied based on the delivery and format of the education as well as the evaluation process.

Surprisingly, the 27 studies included were published in 25 different peer-reviewed journals. These journals spanned many fields and sectors (eg, journals with a focus on education, brain injury, and sports medicine), and therefore, may be targeting different end users. This may make it challenging to gain a clear and comprehensive picture of the concussion education available for those seeking information published in this area. The included studies were also conducted in 13 countries, however, most studies were published in the United States. Of the 27 studies, 26% reported participants from North America, 30% from Europe, 11% from Australia, 11% from Asia, and 11% from South America. Given that the studies in this review were delivered within the school setting where most individuals are not involved in athletics, the emphasis on delivery of education within sport environments is somewhat unexpected. In addition, this focus on the sport environment may have led to limited concussion education in other contexts, including the school setting. When delivering concussion education, it is important to consider that every audience should have access to concussion education and that specific learning needs may be met by different strategies and methods of delivery.

When categorizing concussion education topics, it was discovered that there are no standards, specifically regarding what topics to cover and what is considered “good” concussion education material. There has also been no consideration regarding modification to education topics depending on the target audience or education setting. Therefore, it
was unsurprising that the concussion topics addressed by the education varied greatly between studies. Given that this study is focusing on concussion education provided in the school setting, it is startling that only about a third of education within studies (37.0%) included information on returning to school after a concussion or managing a concussion in the school setting. It is important that return to school is discussed in concussion education delivered in the school setting so that children and youth are supported when returning to school and receive the appropriate accommodations. In order to promote positive change in concussion knowledge, attitudes, and behaviors, it is essential that concussion education be tailored to the setting that it is delivered.

As recommendations from the recent International Consensus Statement on Concussion in Sport and policy implemented by the Ministry of Education in Ontario, Canada outline that concussion education should be provided to all individuals within the school, development of standards for key concussion education topics is warranted. The development of these standards would help to ensure that individuals who work and attend school are educated on relevant school-specific topics and that these are included in the education so that they are able to appropriately respond to a concussion when it occurs.

Across the studies included in this review, the most common way for education to be delivered was from, or in the presence of, a member of the research team (44.4%). It is important to note that all studies involving a member of the research team consisted of an in-person component. When considering this delivery format, the sustainability and feasibility should be examined, specifically the ability for the education to continue beyond the research study. In order for concussion education to continue to develop and have a positive and lasting impact on end users, more sustainable methods of delivery should be considered, such as online, train the trainer, self-directed, or school-led models. Sustainability and feasibility of the education should also be balanced with other factors such as the target audience, specific setting within the school and resources available (eg, access to internet). With these factors in mind, concussion education delivered should be tailored to meet the goals and outcomes of the education.

Despite the majority of studies providing a description of how the education was developed, this description varied greatly between studies. Among studies that referenced existing resources in the education development, the most commonly referenced documents included those developed by the CDC. As 23 studies (85.2%) were published in the United States, it is not surprising that the most commonly referenced documents were from the CDC, as this is the American health protection agency that provides public health education including resources specific to concussion. Basing the development of education on local resources is one way to ensure that content is culturally relevant and applicable (eg, languages used) to the location of the education. Although the majority of studies referenced existing resources in the development of the education, as the field of concussion is rapidly progressing with new evidence and best practices, it is important that these resources and the resulting concussion education is updated to best reflect the current evidence.

Although studies used a range of evaluation methods, all studies included some evaluation of the education. This was somewhat expected and may have been dictated by the research question which focused on peer-reviewed literature where it may be less common to describe concussion education without discussing how it was evaluated. Studies varied in their use of evaluation methods from methods newly designed by the research team specifically for the education delivered, modifying previously used evaluation methods, using previously developed evaluation tools or using a combination. Although there are existing concussion evaluation tools for a variety of audiences including students and coaches, it is important that there is consistency between the tools used, the intended audience, and the outcomes evaluated. The compatibility between the evaluation tools used, the outcomes desired and the education delivered could be explored in future studies.

Another finding when exploring the education evaluation was the use of long-term evaluation that assessed retention. Only 8 studies (29.6%) included in this review captured long-term evaluation of outcomes. Among studies that included long-term evaluation, some have demonstrated that not all effects from educational interventions were sustained. Therefore, the long-term retention of outcomes and impact of education on these audiences is unknown for many of these studies.

Limitations

A limitation of this study was that only published and peer-reviewed primary literature was included in this review. As concussion education provided in the school setting may not be published in scholarly journals, future research and knowledge syntheses should focus on searching gray literature to identify additional concussion education conducted in the school setting. The addition of searching gray literature may provide a more up-to-date and comprehensive picture of all the concussion education being provided in the school setting. Another limitation was that studies had to be written in English to be included in this scoping review. This was due to feasibility.
and the primary language spoken by team members and therefore, studies written in other languages that provide concussion education in the school setting may have been excluded. In addition, as with any scoping review, this study did not evaluate the quality of the studies or the educational interventions they provided. Further research should assess the quality of these studies and the educational interventions they provide, in order to make recommendations on these components.

Conclusions
Overall, this scoping review identified 27 peer-reviewed studies that delivered concussion education to students, coaches, educators, parents, and a mixed audience within the school setting. Providing education within the school setting can help to educate a large number of individuals and has the potential to build a more supportive environment for children and youth surrounding concussion. This study identified gaps and areas for improvement in concussion education that is currently delivered including a lack of clear guidelines for concussion education content, questionable sustainability of the education delivery and the need for long-term evaluation of outcomes. This study provides a foundation for future concussion education delivery in school settings to ensure that children, youth and those that interact with and support them are appropriately educated about concussion.

IMPLICATIONS FOR SCHOOL HEALTH
Since there are recommendations and mandates for the development of concussion policies that include concussion education in schools, this study can provide a foundation for the development of future concussion education. This scoping review identified concussion education delivered in the school setting and highlighted the importance of considering the context, delivery method, development, and evaluation of the education. Concussion education should be tailored to individuals within the school setting by working with stakeholders and considering the audience, setting, concussion topics, sustainability, and feasibility of the education. As this study identified a lack of standards for concussion topics that should be addressed, future efforts should be focused on the development of standards for concussion education topics within schools. Development of these standards will help to ensure that concussion education delivered in the school setting includes comprehensive concussion topics and delivery methods that are suitable for the target audience. In addition, this study outlined strategies for education development and potential approaches to evaluation of concussion education. This study summarized concussion education delivered in the school setting and identified key areas of consideration for the development of future concussion education in order to meet current recommendations and mandates.

Human Subjects Approval Statement
Completion of this scoping review did not involve research with human subjects.

Conflict of Interest
NR is a holder of a Canada Research Chair (Tier 2) in Pediatric Concussion and reports receiving grants and research funding from the Canadian Institutes of Health Research (CIHR), Ontario Neurotrauma Foundation (ONF), Public Health Agency of Canada (PHAC), Parachute Canada, Special Olympics Canada, Greater Toronto Hockey League, Dr. Tom Pashby Sport Safety Fund, Holland Bloorview Kids Rehabilitation Hospital and Scotiabank. NR is an investigator in a multicenter study funded by the National Football League (NFL) Scientific Advisory Board; he does not receive any research funding or financial benefit. NR is a minority shareholder in 360 Concussion Care, an interdisciplinary concussion clinic.

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