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Prevalence of Suspected Concussions Among K-12 Students in Utah: Findings From Utah's Student Injury Reporting System

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Abstract

BACKGROUND: To inform prevention strategies, this study provides incidence, factors, and actions taken when a suspected concussion occurred in K-12 schools in Utah.

METHODS: Data were collected using Utah's Student Injury Reporting System (SIRS) from the academic years 2011–2012 to 2018–2019. SIRS is a unique online system that tracks injuries that occur in the school setting among K-12 students in Utah. Descriptive statistics were computed to characterize students with a suspected concussion. Chi-square (χ^2) analysis looking at characteristics by school level was also conducted.

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Human Subjects Approval Statement

This research was reviewed and approved by the Institutional Review Board of the Utah Department of Health.

Conflict of Interest

All authors of this article declare they have no conflicts of interest. The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

RESULTS: Over 63,000 K-12 students in Utah sustained an injury at school during the study period. Suspected concussions comprised 10% of all injuries. The prevalence of concussions was highest among males (60.6%) and elementary school students (42.6%) and most often occurred outdoors (57.6%) or on a playground/playfield (33.9%), and in sports- and recreation-related activities (75.1%) (specifically contact sports, 24.0%). Most students with a suspected concussion were absent 1 day or less from school (71.4%) but about 68% were seen by a medical professional. Further, there were differences by school level. Females and students playing contact sports had a higher percentage of suspected concussions as school level increased, whereas males and concussions sustained during school hours had a lower percentage of suspected concussions as school level increased.

CONCLUSIONS: SIRS enables schools in Utah to identify groups at risk for concussion, as well as activities most commonly associated with these injuries, within the school environment. Using this information, schools may implement targeted prevention strategies to protect students.

Keywords

concussion; injury; surveillance; kids; children; schools

Approximately 1 in 5 youth report having experienced a concussion during their lifetime.[1] Caused by an external force to the head or a jolt to the body, youth with a concussion may experience symptoms (e.g., headache, nausea, irritability, confusion, difficulty with cognition and memory)[2,3] that affect their ability to participate in regular activities, including school, during recovery.[4,5] During childhood and adolescence, organized sports activities (e.g., football, soccer) contribute to the majority of concussions among school-age children (age 6 years and older).[1,6] A recent study also found that concussions commonly occur when children are at school.[7] Additionally, males, children aged 10–14 and 15–17 years old, and contact sports had higher rates of pediatric emergency department visits for sports- and recreation-related activities, though for younger children playground activities did account for a large percentage as well.[8] However, most published research focuses on concussions that occur during sports- and recreation-related activities, especially during contact sports and are mostly focused on high school and college-age athletes. Important information is therefore missing about concussions that occur at school.

A study of pediatric patients seen in a sports concussion clinic found that concussions sustained at school most commonly occurred when a student was participating in physical education (PE) class, in a classroom, at recess, or in the hallway.[7] However, the context and circumstances that lead to a concussion in the school setting, as well as the action taken in response to the injury, has not been described in the published literature. Appropriately responding to a concussion can reduce the risk for adverse outcomes and a prolonged recovery.[9] Additionally, proper management of a youth's return to school can help reduce the potential for extended absence from school, declines in school performance, and feelings of isolation that a student may experience after their injury.[4,5]

Limited data on concussion in schools inhibits the development of school-based concussion prevention and management efforts that can support a student's academic progress as well as physical and mental health. There is a need for a comprehensive surveillance system that

can regularly report nationally representative estimates of concussion. Until such a system is instituted, there are other data sources from which researchers may gather select information about the concussion experiences of individuals, particularly those of school-age children. This study examines unique data from a state-based student injury reporting system in order to understand the concussion experience of K-12 students. Differences among those with a suspected concussion by key demographic factors and circumstances (ie, age, sex, number of days missed from school, mechanism of injury, activity, location, and action taken after injury) are presented.

METHODS

Data were collected using Utah's Student Injury Reporting System (SIRS) for the academic years 2011–2012 through 2018–2019. SIRS is a unique online system that tracks injuries (eg, suspected concussion, cut/laceration, burn/scald) that occur in the school setting among K-12 students in Utah. SIRS has an estimated annual school participation rate of 90%−95%. The system is voluntary and is based on an original agreement, when the system was first developed, by the Utah Department of Health and the state board of education. All 41 school districts across Utah contribute to SIRS, which is inclusive of over 800 public schools. SIRS tracks injuries that occur while a student is traveling to and from school, while a student is at school, and when a student is participating in school-based sports and other nonsports activities (before and after school). Injuries are recorded using a standardized form to capture injury information (ie, student information, the cause, what the student was doing at the time of injury). Injuries are recorded if the injury is severe enough to (a) cause the loss of one-half day or more of school, (b) warrant medical attention and treatment (ie, school nurse, outside health care provider, emergency department visit) and/or (c) require reporting according to School District policy. The individuals who complete the form vary by school, but may include the student, teacher, administrative assistant, school nurse, or athletic trainer. Once the form is completed, the information is entered into the SIRS database by a person designated by the school. The designated person is primarily a school administrative assistant but may also include other personnel such as a school nurse. If the injury is severe enough to warrant medical attention and/or the student misses a half-day or more of school due to the injury, the incident is not submitted until the information can be obtained. The SIRS coordinator at the Utah Department of Health verifies the data are complete and accurate for each incident. IRB approval was obtained from the Utah Department of Health.

Instrumentation

The standardized injury reporting form collects demographic information, such as the student's grade and sex (Appendix A). Details on the student's injury that are captured by the form include: the date of injury, number of days the student was absent following the injury (days absent) (less than ½, ½, 1, 1½−2, 2½−3, and fill in the blank if more than 3 days), and nature of the injury (abrasion/scrape, bump/bruise/contusion, burn/scald, concussion [possible], cut/laceration, dislocation [possible], fracture/broken [possible], loss of consciousness, no pulse/heartbeat, not breathing, pain/tenderness only, puncture, shortness of breath, sprain/strain/tear, swelling/inflammation, other). To determine how the

injury occurred, contributing factors (ie, mechanism of injury [MOI]) were captured in the form. MOI categories included: animal bite (eg, dog bite); collision with object or person; compression/pinch; contact with equipment (shop, PE); contact with fire, hot liquid or hot object; drug, alcohol or other substance; fall; foreign body/object; hit with thrown object; overexertion/twisted; seizure disorder; tripped/slipped; unknown; weapon (gun, knife, etc.); or other. To determine how the injury was managed, action taken was reported. Actions taken included: remained or returned to class, sent/taken home, parents deemed no medical action necessary, checked by school nurse, checked by emergency medical technician on staff, called 911, seen by M.D./emergency department/health care provider/hospital, hospitalized, restricted school activity, or other. Location, surface, and activity associated with the injury are also recorded. Location of the injury included: athletic field, auditorium/multipurpose room, bus loading area, classroom, corridor/hall (excluded stairs), doorway, gymnasium, lab (home economics classroom, chemistry lab, etc.), lunchroom/kitchen, playground/playfield, school bus/public bus, shop (industrial arts, etc.), sidewalk/stairs/ramp, street/driveway/parking area, restroom/lavatory, or other. Surfaces included: black-top surface, carpet, concrete, dirt, gravel, ice/snow, lawn/grass, mats, sand, synthetic surface (ie, Tartan surface), tile, wood (waxed), shredded rubber/wood chips, and other. Finally, activity during which the injury occurred included: baseball/softball, basketball, bicycling, classroom activity, climbing, dodge ball/war ball, fighting, flag/touch football, football, gymnastics/tumbling, jumping, kickball, playing on bars (monkey bars/big toy/etc.), riding, running, roughhousing, setting up/moving equip, sliding, sliding on ice, sitting, soccer, standing, swinging, throwing rocks or snowballs, track and field, volleyball, walking, wrestling, 4-square, dance, frisbee, other.

Data Analysis

Descriptive statistics were computed for those students with a suspected concussion by demographic factors, surface, location of injury, MOI, activity, days absent, and action taken. Prior to the analysis, certain variables were further condensed due to low frequencies or categories that shared comment elements: surface was categorized into a 3-level variable (outdoor, indoor, and other); location was collapsed into a 5-level variable (playground/playfield, gymnasium, athletic field, classroom, and other); MOI was classified into a 3-level variable (struck by or against, fall, and other/unknown); activity during which the injury occurred was first classified into a 3-level variable by whether it was a sports- or recreation-related (SRR) activity, a non-SRR activity, or “other” category (ie, if an activity was labeled as “other”). Next, activities that were classified as an SRR activity were further categorized into a 4-level variable by level of contact.[10,11] These levels included contact sports (eg, football), limited contact sports (eg, baseball/softball), noncontact sports (eg, running), and recreation (eg, walking); and action taken was classified as 8 separate binary variables: yes and no for remained/returned to class, sent/taken home, seen by a medical professional, restricted school activity, called 911, admitted to hospital, and transported by ambulance; no action taken and action taken for none of the above.

A chi-square (χ^2) analysis looking at characteristics by school level was also conducted. When statistical significance was found for χ^2 tests ($p < .05$), a post-hoc proportions test

with a Bonferroni correction was applied. The statistical package SAS version 9.4 (Cary, NC) and IBM SPSS Statistics Subscription were used to analyze the data.

RESULTS

During the 8-year study timeframe, 63,168 injuries were recorded among K-12 students across Utah. Approximately 10% of all reported injuries were suspected concussions (N = 6289). Male students (60.6%) and those in elementary school (42.6%) made up a greater proportion of students with a suspected concussion than female students (39.4%) and those in middle school/junior high (24.9%) and high school (27.2%) (Table 1). Nearly 6 in 10 (57.6%) of suspected concussions occurred on an outdoor surface (Table 2). About one third (33.9%) specifically happened on a playground/playfield. Over half (55.9%) of students with a suspected concussion sustained their injury by being struck by or against something (Table 3). Smaller percentages of suspected concussions occurred due to a fall (41.6%) or another mechanism of injury (2.5%). SRR activities were responsible for the majority of suspected concussions (75.1%). Of the suspected concussions associated with SRR activities, approximately a fourth (24.0%) occurred when the student was participating in a contact sport, which was higher than limited contact sports (11.9%), noncontact sports (17.2%), and recreation (22.0%). A suspected concussion occurred most frequently during school (76.1%) (Table 4). Following a suspected concussion, about 4 in 10 students were absent less than half a day (40.9%) and an additional 30.5% were absent between a half a day to a full day. Further, a majority of students with a suspected concussion were sent or taken home (59.9%) and saw a medical professional (68.1%). Smaller percentages of students with a suspected concussion had their school activities restricted (22.0%), called 911 (5.7%), were admitted to the hospital (2.1%), or were transported by ambulance (3.2%). For 6.5% of students, none of the actions listed above (ie, remained/returned to class, sent or taken home, seen by a medical professional, restricted school activity, called 911, admitted to the hospital, or transported by ambulance) was taken after a suspected concussion. A more detailed breakdown of concussion by demographic factors and other characteristics is provided in Tables 1–4.

For the chi-square analysis examining school level (elementary school, middle/junior high, high school) by characteristics (Table 5), there was a statistically significant lower percentage of suspected concussions for males (68.1%, 62.7%, 46.1%) as school level increased, whereas a higher percentage of suspected concussions for females (31.9%, 37.3%, 53.9%) as school level increased. There was a greater percentage of concussions for SRRs activities in elementary schools (80.9%) compared to middle/junior high schools (70.5%) and high schools (71.6%). Contact sports contributed to a greater percentage of suspected concussions as school level increased as well. There was also a lower percentage of concussions sustained during school (90.1%, 83.2%, 45.4%) as school level increased. The greatest percentage of concussions seen by a medical professional occurred in elementary (70.3%) and high schools (72.7%) vs middle/junior high schools (61.4%). Lastly, none of the above for action taken was more common as school level increased (4.1%, 7.2%, 9.7%). Further details are provided in Table 5.

DISCUSSION

Findings from an analysis of K-12 school-related injuries in Utah show that over 63,000 students sustained a reported injury at school between the 2011–2012 and 2018–2019 academic years. Suspected concussions comprised 10% of injuries that occurred among students captured by this data. While schools provide a safe environment for students to learn and play, factors such as playground usage,[8] participation in contact sports,[8] and improper or inadequately maintained equipment or playing surfaces[12,13] may increase the risk for concussions.

SRR activities in schools afford students many physical and mental health benefits.[14] However, as noted in this and other studies, students are at increased risk for injury while participating in SRR activities at all school levels.[6,7] A higher percentage of students experienced SRR in elementary school compared to middle and high school. Contact sports accounted for approximately one fourth of SRR concussions in this study and was more prevalent as school level increased. Contact sports place students at increased risk for concussion primarily due to the possibility of collisions with other athletes.[15] The use of contact restrictions and noncontact sport options,[16,17] rule changes that reduce high-risk activities,[18–21] and strict officiating,[22,23] are promising strategies schools may implement to reduce the risk for concussions in contact sports. Due to limited evidence, future research may be conducted to identify effective strategies to reduce physical activity-related injuries in school, both in and outside of organized sports.[24]

Suspected concussions most commonly occurred while a student was on a playground/playfield in elementary school. Proper maintenance and repair of playing surfaces[25–27] and proper use and fit of equipment (eg, helmets)[28–30] may help reduce the risk for concussions and other injuries during play. Prior studies note that playground use, such as playing on the monkey bars and swings, is associated with the most emergency department visits for SRR traumatic brain injuries, including concussions among elementary school-age children in the United States.[8,31] Use of protective (or shock-absorbing) surfacing, such as sand and wood chips, are considered best for use under playground equipment to reduce injury risk.[13,32] Other strategies[13] to promote playground safety include: installing guardrails and protective barriers that mitigate fall risk from an elevated platform; ensuring that playground equipment is age-appropriate; and, always having adult supervision when students are using the playground or other pieces of equipment. These targeted strategies can be adapted for the needs of each school and based on what resources they have to help promote safety.

To our knowledge, this is the first study to examine differences in concussion prevalence by school level across a statewide school system. A large percentage of concussions in this study were observed among elementary school students. However, the analysis by school level demonstrated that the percentages of suspected concussion shifted for certain demographics and characteristics as school level increased from elementary, to middle school, and then to high school. For example, among females and students playing contact sports the percentage of suspected concussions increased along with school level. Conversely, the percentage of concussions decreased among males and among students who sustained a suspected concussion during school hours as school level increased. It is

unclear why these differences occurred, and this analysis did not allow for an examination of what may contribute to these differences. To explore this, future studies may assess whether differences between older and younger students play a role, such as those regarding: participation in contact sports (such as football) and sex comparable sports (such as soccer); level of intensity of play during sports; involvement in different types of SRR activities; concussion awareness and reporting behaviors; risk-taking behaviors; and a student's independence (eg, lack of parental supervision) outside the school hours.

More than 5000 school days are missed each year because of concussions and other injuries among students in Utah.[33] Following concussion management recommendations that ensure students seek medical care, rest at home immediately after the injury and receive school accommodations (activity changes/restrictions) may assist with their recovery.[34] Findings from this study demonstrate that students with a suspected concussion were commonly sent home from school, visited a medical professional, and had a period of restricted school activity following their injury. This suggests that, in general, schools in Utah took several actions aimed at supporting a student's recovery following a concussion. Still, concussion management is not consistent among states,[35,36] and these findings are not universal. Previous studies indicate that some health care providers and school professionals may struggle with how to help students to return to school following a concussion.[37–39]

Laws and policies providing guidance for return to play for student athletes following concussion are in 50 states; however, guidance for return to learn at school is only present in 8 states.[40] Current policies cover students who experience a sports-related injury and offer little guidance and education for teachers.[40] In March 2021, the Utah State Board of Education (USBE) unanimously passed an update to the current rule to expand their existing state RTP policy for students with any suspected head injury experienced during school hours or a school sanctioned activity to be reported to a parent. While this rule currently excludes mandating reporting to parents when a suspected head injury occurs during free play, their policy was updated to reflect the changes and to include free play and RTL guidance. The existing state law in Utah had already included reporting of suspected concussion of students participating in physical education and extracurricular sporting events. This new rule will lead to a more inclusive adoption of RTP policies, reporting, and recovery.

Findings from this study indicate that concussions can occur from other injury mechanisms, even during younger ages, and may result in persistent symptoms, highlighting the need for improved guidance for return to school. A number of trainings have been developed that may be beneficial. These include trainings about how to support students with individualized, symptom-based return to school plans[41,42]; promote professional development for health care providers and educational professionals (inclusive of continuing education credits)[39,43]; seek to develop student support teams[44]; and highlight return to school strategies to guide educators about concussion-specific accommodations that can be utilized.[45]

As part of their responsibilities, school nurses often write health plans for students who experience concussions or other injuries. However, school nurses are not always available

when concussions are reported and may not have training on concussion identification and management.[46,47] In Utah, the ratio of school nurses to students is 1:3595—indicating that many students are not sufficiently covered by a school nurse in this state.[48] Furthermore, Healthy People 2020 and the American Academy of Pediatrics recommend 1 school nurse to 750 students. Education and training for nurses as school health care providers, such as CDC's HEADS UP to health care providers (https://www.cdc.gov/headsup/providers/training/index.html), can help train nurses on how to appropriately respond to concussions and safely return the students to school.[49]

Limitations

There are at least 6 limitations to our study. First, participation is voluntary in SIRS. It is possible that the schools that do not submit data may be systematically different from the ones that do submit data, which might lead to somewhat biased results. Second, suspected concussion was not always confirmed by a medical professional in the data (51.7% of suspected concussions had a confirmed diagnosis). However, SIRS does not capture the type of provider that provides this diagnosis. Parents usually report the diagnosis to the school or the student brings a medical note to the school, and then the information is updated in SIRS. It is therefore possible that some of the suspected concussions would not be diagnosed as concussions and that suspected concussions may be underreported. Third, the data are collected from a single state and may not be generalizable to other states. Fourth, data are limited to public schools; injury experiences in private school students may differ. Fifth, the person filling out the form is not consistent; anecdotal reports suggest that administrative assistants most commonly complete the form, but sometimes it was filled out by a school nurse. School nurses and athletic trainers are more likely to have a greater level of knowledge about injuries than other sources (ie, the student, administrative assistant, or teacher) and therefore may be able to provide more detailed, accurate information on the injury. Lastly, there is no information about how many school injuries are not captured by SIRS. It is possible that the numbers here represent an undercount of the true injury burden among public school students in Utah.

Conclusions

Using data from a large sample of school-related injuries in Utah, this paper provides the incidence of concussion and concussion risk factors in the school setting, and describes actions taken when a concussion was suspected. Overall, the percentage of concussions was highest among elementary school students and during sports- and recreation-related activities, particularly in contact sports. Students with a suspected concussion were likely to be sent home from school and see a medical professional following their injury. It is useful for schools to have access to concussion data in order to adapt or create school-based concussion prevention and management efforts that support students. Utah's SIRS serves as a good model for a school surveillance system that other states may adopt.

IMPLICATION FOR SCHOOL HEALTH

Documentation of injury incidents has played a vital role in helping protect schools or students when a situation escalates and legal issues surface. It also provides a method to

identify injuries that require follow-up at school, including academic support. The Utah reporting system is voluntary and unfunded but has been a priority for the state health department, as many schools and districts find value in collecting this data and compiling historical data to monitor injuries over time. This system also helps school districts to understand the cause and location of injuries and can be used to implement targeted prevention strategies (eg, limiting contact during sports activities, ensuring appropriate play surfaces and equipment maintenance) to protect students from concussion. The viability of this system depends upon having a designated school staff member who is trained and responsible for identifying and tracking every child who reports a concussion when they return to school, regardless of injury severity and injury mechanism. An individualized return to school and play/activity plan that is communicated to all school personnel who work with a child reduces the likelihood that a student has a decline in school performance or altered behavior after a concussion. When a child sustains a concussion at school, parents can be encouraged to seek an evaluation from a health care professional.

Appendix.: Student Injury Reporting Form, Utah Department of Health, Violence & Injury Prevention Program

STUDENT INJURY REPORT FORM
UTAH DEPARTMENT OF HEALTH
VIOLENCE & INJURY PREVENTION PROGRAM

This form is to be completed immediately following the occurrence of any injury that is severe enough to: (a) cause the loss of one-half day or more of school, (b) warrant medical attention and treatment (i.e. school nurse, M.D., E.R., etc.) and/or, require reporting according to School District policy. Additional instructions on back.

1. Child's Name _____ 5. Date of Birth ___/___/___ (mo day yr) 8. Date of Injury ___/___/___ (mo day yr)
2. Parent's Name _____
3. District Name _____ # _____ 6. Grade _____ 9. ( ) Male ( ) Female
4. School Name _____ # _____ 7. Time of Injury _____ ( ) am ( ) pm 10. Fatal ( ) Yes ( ) No

11. DAYS ABSENT: *Record letter of the DAYS absent from school related to this injury in box at left. If no absence, record letter "a".*
☐ a) Less than 1/2 b) 1/2 c) 1 d) 1 1/2 - 2 e) 2 1/2- 3 f) If more than 3 days, then specify # _____ days

12. ACTION TAKEN: *PLEASE CHECK AND COMPLETE ALL THAT APPLY.*

	TIME:	BY WHOM (Title codes on back)
1. ☐ First aid administered	_____ ( ) am ( ) pm	_____ Specify name _____
2. ☐ Parent or guardian notified	_____ ( ) am ( ) pm	_____ Specify name _____
3. ☐ Unable to contact parent/guardian	_____ ( ) am ( ) pm	
4. ☐ Remained in or returned to class		9. ☐ Called 911
5. ☐ Sent/taken home		10. ☐ Seen by M.D./E.R./health care provider/hospital/etc. Diagnosis: _____
6. ☐ Parents deemed no medical action necessary		11. ☐ Hospitalized Specify length: _____
7. ☐ Checked by school nurse		12. ☐ Restricted school activity Specify length: _____
8. ☐ Checked by EMT on staff		13. ☐ Other-Specify

13. NATURE OF INJURY: *List the injuries/symptoms incurred. (Record # in boxes at left.)*

☐ More Severe	1. Abrasion/Scrape	5. Cut/Laceration	9. No Pulse/Heartbeat	13. Shortness of Breath
☐ Less Severe	2. Bump/Bruise/Contusion	6. Dislocation (possible)	10. Not Breathing	14. Sprain/Strain/Tear
	3. Burn/Scald	7. Fracture/Broken (possible)	11. Pain/Tenderness Only	15. Swelling/Inflammation
	4. Concussion (possible)	8. Loss of Consciousness	12. Puncture	16. Other

14. AREA AFFECTED: *List area affected for each injury/symptom code listed in 13 above. (Record # in boxes at left.)*

	HEAD		TRUNK		EXTREMITIES	
☐ More Severe	1. Chin/Cheek	6. Neck/Throat	10. Stomach	15. Genitalia	19. Ankle	24. Hand/Wrist
☐ Less Severe	2. Ear	7. Nose	11. Back	16. Internal	20. Arm	25. Knee
	3. Eye	8. Head	12. Buttocks	17. Pelvis/Hip	21. Elbow	26. Leg
	4. Forehead	9. Tooth/Teeth	13. Chest/Ribs	18. Shoulder	22. Finger/Thumb	27. Toe
	5. Mouth/Tongue/Lip		14. Collarbone		23. Foot	

15. CONTRIBUTING FACTOR: *List factor which may have led to the injury. (Record # in box at left.)*

☐	1. Animal bite (dog bite etc.)	5. Contact with fire, hot liquid or hot object	9. Hit with thrown object
	2. Collision with object or person	6. Drug, alcohol or other substance	10. Overexertion/Twisted
	3. Compression/Pinch	7. Fall	11. Seizure disorder
	4. Contact with equipment (shop, P.E.)	8. Foreign body/Object	12. Tripped/Slipped

13. Unknown
14. Weapon (gun, knife, etc.) Specify _____
15. Other _____

16. PERIOD: *List period during which injury occurred. (Record # in box at left.)*

☐	1. After school	4. Athletic practice session	7. Class time (exclude PE)	10. Lunch	13. P. E. class
	2. Assembly	5. Before school	8. Field trip	11. Lunch recess	14. Other _____
	3. Athletic event (team competition)	6. Class change	9. Intramural competition	12. Recess	

17. SURFACE: *List surface on which injury occurred. (Record # in box at left.)*

☐	1. Blacktop	4. Dirt	7. Lawn/Grass	10. Synthetic surface (i.e.Tartan surface)	12. Wood(waxed)
	2. Carpet	5. Gravel	8. Mats		13. Other _____
	3. Concrete	6. Ice/Snow	9. Sand	11. Tile	14. Shredded Rubber/Wood Chips

18. LOCATION: *List location at which injury occurred. (Record # in box at left.)*

☐	1. Athletic field	5. Corridor/Hall (exclude stairs)	9. Lunchroom/Kitchen	13. Sidewalk/Stairs/Ramp
	2. Auditorium/Multipurpose	6. Doorway	10. Playground/Playfield	14. Street/Driveway/Parking Area
	3. Bus loading area	7. Gymnasium	11. School bus/Public bus	15. Restroom/Lavatory
	4. Classroom	8. Lab (Home Ec., Chem, etc.)	12. Shop (Industrial Arts, etc.)	16. Other _____

19. ACTIVITY: *List activity during which injury occurred. (Record # in box at left.)*

☐	1. Baseball/Softball	7. Fighting	13. Playing on bars (monkey bars/big toy/etc.)	18. Sliding	24. Throwing rocks or snowballs	29. 4-Square
	2. Basketball	8. Flag/Touch football		19. Sliding on ice		30. Dance
	3. Bicycling	9. Football	14. Riding	20. Sitting	25. Track and field	31. Frisbee
	4. Classroom activity	10. Gymnastics/Tumbling	15. Running	21. Soccer	26. Volleyball	32. Other _____
	5. Climbing	11. Jumping	16. Roughhousing	22. Standing	27. Walking	
	6. Dodge ball/War ball	12. Kickball	17. Setting up/Moving equip	23. Swinging	28. Wrestling	

20. EQUIPMENT: Was equipment or apparatus involved in injury? ☐ Yes ☐ No IF YES (a) Did equipment appear to be used appropriately? ☐ Yes ☐ No
Specify equipment _____ (b) Was there any apparent malfunction of equipment? ☐ Yes ☐ No

21. DESCRIPTION: Describe specifically how the injury happened: _____

22. _____ Signature of Person Making Report Title Code _____ 23. _____ Principal's Signature

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Table 1.

Characteristics of Sex and School Level of Suspected Concussion Among K-12 Students in Utah, Student Injury Reporting System, 2011–2012 to 2018–2019 Academic Years

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
Sex		
Male	3808	60.6
Female	2471	39.4
School level		
Elementary school	2678	42.6
Middle/junior high school	1567	24.9
High School	1713	27.2
Other *	330	5.2

* Includes special, alternative, intermediate, and charter schools.

Table 2.

Characteristics of Surface and Location of Suspected Concussion Among K-12 Students in Utah, Student Injury Reporting System, 2011–2012 to 2018–2019 Academic Years

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
Surface		
Outdoor	3623	57.6
Lawn/grass	1280	20.4
Blacktop	727	11.6
Concrete	515	8.2
Shredded rubber/wood chips	462	7.4
Synthetic surface (spongy surface)	276	4.4
Ice/snow	214	3.4
Sand	56	0.9
Dirt	47	0.8
Gravel	46	0.7
Indoor	2589	41.2
Wood (waxed)	1179	18.8
Tile/linoleum	752	12.0
Carpet	369	5.9
Mats	289	4.6
Other	77	1.2
Location		
Playground/playfield	2131	33.9
Gymnasium	1527	24.3
Athletic field	913	14.5
Classroom/Lab (home economics, chemistry, etc.)/Shop (industrial arts, etc.)	427	6.8
Other *	1291	20.5

* Includes auditorium/multipurpose, bus loading area/school bus/public bus, corridor/hall (excludes stairs), doorway, lunchroom/kitchen, sidewalk/stairs/ramp/street/driveway/parking area, restroom/lavatory.

Table 3.

Mechanism of Injury (MOI) and Activity Conducted When Suspected Concussion Occurred Among K-12 Students in Utah, Student Injury Reporting System, 2011–2012 to 2018–2019 Academic Years

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
MOI		
Struck by or against	3515	55.9
Collision with object or person	2993	47.6
Hit with thrown object	324	5.2
Contact with equipment (shop, PE, sharp object)	187	3.0
Foreign body/object	11	0.2
Fall	2615	41.6
Tripped/slipped	1371	21.8
Fall	1244	19.8
Other/unknown	159	2.5
Unknown	70	1.1
Other	47	0.8
Seizure disorder	21	0.3
Overexertion/twist	14	0.2
Compression/Pinch	4	0.1
Contact with fire, hot liquid or hot object	1	0.0
Drug, alcohol, or other substance	1	0.0
Weapon (gun, knife, etc.)	1	0.0
Animal bite	0	0.0
Activity *		
Sports- and Recreation-Related Activities	4726	75.1
Contact level of sport		
Contact sports	1510	24.0
Basketball	546	8.7
Football	497	7.9
Soccer	399	6.3
Wrestling	68	1.1
Limited contact	749	11.9
Baseball/softball	133	2.1
Flag/touch football	188	3.0
Gymnastics/tumbling	293	4.7
Volleyball	99	1.6
Riding	36	0.6
Non-contact	1084	17.2
Running	990	15.7
Weightlifting	30	0.5
Track and field	27	0.4

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
Dance	22	0.4
Frisbee	7	0.1
Bicycling	8	0.1
RECREATION	1383	22.0
Walking	593	9.4
Playing on the bars (monkey bars/bog toy, etc.)	318	5.1
Climbing	97	1.5
Dodge ball/War ball	65	1.0
Kickball	71	1.1
Jumping	71	1.1
Sliding	64	1.0
Swinging	68	1.1
Sliding on ice	32	0.5
4-Square	4	0.1
Non-sports- and recreation-related activities	996	15.8
Classroom activity	181	2.9
Fighting	48	0.8
Roughhousing	224	3.6
Setting up/moving equipment	30	0.5
Sitting	202	3.2
Standing	305	4.9
Throwing rocks or snowballs	6	0.1
Other	567	9.0

*Activity was classified into a 3-level variable by whether it was a sports- or recreation-related (SRR) activity, a non-SRR activity, or “other” category (ie, if an activity was labeled as “other”). Next, activities that were classified as an SRR activity were further categorized into a 4-level variable by level of contact.

Table 4.

Period, Number of Days of Absence, and Action Taken After Suspected Concussion Among K-12 Students in Utah, Student Injury Reporting System, 2011–2012 to 2018–2019 Academic Years

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
Period		
Before or after school*	1420	22.6
During school hours†	4785	76.1
Other	84	1.3
Absence		
No absence or Less than ½ day	2571	40.9
½ day to 1 day	1918	30.5
2 days	870	13.8
3+ days	929	14.8
Action taken		
Remained/returned to class		
Yes	803	12.8
No	5486	87.2
Sent/taken home		
Yes	3769	59.9
No	2520	40.1
Seen by a medical professional‡		
Yes	4280	68.1
No	2009	31.9
Checked by school nurse		
Yes	350	5.6
No	5939	94.4
Checked by EMT on staff		
Yes	233	3.7
No	6056	96.3
Seen by MD/ER/Healthcare provider/Hospital		
Yes	4083	64.9
No	2206	35.1
Restricted school activity		
Yes	1383	22.0
No	4906	78.0
Called 911		
Yes	359	5.7
No	5930	94.3
Admitted to hospital		
Yes	132	2.1

	Suspected Concussion (N = 6289)	
Characteristic	**N**	**%**
No	6157	97.9
Transported by ambulance		
Yes	203	3.2
No	6086	96.8
None of the above		
Yes	408	6.5
No	5881	93.5

[*] Includes before and after school, athletic event (team competition), athletic practice session, and intramural competition.

[†] Includes assembly, class change, class time (exclude P.E.), field trip, lunch, lunch recess, recess, and P.E. class.

[‡] The same child may have been seen by more than one medical professional.

Table 5.

Chi-Square Analysis of Characteristics of Students by School Level of K-12 Students With Suspected Concussion in Utah, Student Injury Reporting System, 2011–2012 to 2018–2019 Academic Years*

	School Level							
	Elementary School		Middle/Junior High School		High School			
Characteristic	**N**	**%**	**N**	**%**	**N**	**%**	**χ^***	**p-Value**
Sex							215.6	<.0001
Male	1822	68.1[a]	980	62.7[b]	789	46.1[c]		
Female	852	31.9[a]	584	37.3[b]	921	53.9[c]		
Surface							918.0	<.0001
Outdoor	2114	78.9[a]	648	41.4[b]	671	39.2[b]		
Indoor	540	20.2[a]	905	57.8[b]	1008	58.8[b]		
Other	24	0.9[a]	14	0.9[a]	34	2.0[a]		
Location							2809.9	<.0001
Playground/playfield	1840	68.7[a]	161	10.3[b]	19	1.1[c]		
Gymnasium	226	8.4[a]	568	36.2[b]	660	38.5[b]		
Athletic field	103	3.8[a]	293	18.7[b]	466	27.2[c]		
Classroom/lab (home economics, chemistry, etc.)/shop (industrial arts, etc.)	130	4.9[a]	137	8.7[b]	139	8.1[b]		
Other†	379	14.2[a]	408	26.0[b]	429	25.0[b]		
MOI							387.3	<.0001
Struck by or against	1159	43.3[a]	988	63.1[b]	1192	69.6[c]		
Fall	1467	54.8[a]	547	34.9[b]	455	26.6[c]		
Other/unknown	52	1.9[a]	32	2.0[a]	66	3.9[b]		
Activity							86.9	<.0001
Sports- and recreation-related activities	2167	80.9[a]	1104	70.5[b]	1226	71.6[b]		
Non-sports- and recreation-related activities‡	343	12.8[a]	299	19.1[b]	285	16.6[b]		

Characteristic	School Level							
	Elementary School		Middle/Junior High School		High School			
	N	%	N	%	N	%	χ^{2*}	p-Value
Other	168	6.3[a]	164	10.5[b]	202	11.8[b]		
Contact level of sport							1130.1	<.0001
Contact sports[§]	388	17.9[a]	453	41.0[b]	582	47.5[c]		
Limited contact sports[‖]	110	5.1[a]	244	22.1[b]	376	30.7[c]		
Non-contact sports[¶]	742	34.2[a]	159	14.4[b]	127	10.4[c]		
Recreation[#]	927	42.8[a]	248	22.5[b]	141	11.5[c]		
Period							1211.0	<.0001
Before/afterschool	245	9.1[a]	241	15.4[b]	900	52.5[c]		
During school[**]	2414	90.1[a]	1303	83.2[b]	778	45.4[c]		
Other	19	0.7[a]	23	1.5[b]	35	2[b]		
Absence							82.9	<.0001
No absence or Less than ½ day	1015	37.9[a]	624	39.8[a]	800	46.7[b]		
½ day to 1 day	849	31.7[a]	503	32.1[a]	442	25.8[b]		
2 days	461	17.2[a]	200	12.8[b]	179	10.4[b]		
3+ days	352	13.1[a]	240	15.3[a,b]	292	17.0[b]		
Action taken								
Remained/returned to class							27.9	<.0001
Yes	281	10.5[a]	251	16.0[b]	230	13.4[b]		
No	2397	89.5[a]	1316	84.0[b]	1483	86.6[b]		
Sent/taken home							434.6	<.0001
Yes	1911	71.4[a]	953	60.8[b]	681	39.8[c]		
No	767	28.6[a]	614	39.2[b]	1032	60.2[c]		
Seen by a medical professional[††]							54.6	<.0001

	School Level							
	Elementary School		Middle/Junior High School		High School			
Characteristic	N	%	N	%	N	%	χ^{*}	p-Value
Yes	1882	70.3[a]	962	61.4[b]	1245	72.7[a]		
No	796	29.7[a]	605	38.6[b]	468	27.3[a]		
Restricted school activity							5.5	.064
Yes	623	23.3	349	22.3	347	20.3		
No	2055	76.7	1218	77.7	1366	79.7		
Called 911							9.9	.007
Yes	129	4.8[a]	77	4.9[a,b]	118	6.9[b]		
No	2549	95.2[a]	1490	95.1[a,b]	1595	93.1[b]		
Admitted to hospital							2.3	.314
Yes	59	2.2	26	1.7	41	2.4		
No	2619	97.8	1541	98.3	1672	97.6		
Transported by ambulance							6.6	.037
Yes	74	2.8[a]	48	3.1[a,b]	71	4.1[b]		
No	2604	97.2[a]	1519	96.9[a,b]	1642	95.9[b]		
None of the above							55.0	<.0001
No action taken	111	4.1[a]	113	7.2[b]	167	9.7[c]		
Action taken	2567	95.9[a]	1454	92.8[b]	1546	90.3[c]		

[*] For post hoc tests, pairwise comparisons of column proportions were computed with a bonferroni correction. Letter superscripts (a, b, c) indicate which pairs of columns for a given row are significantly different, $p < 0.05$. If a pair of values are significantly different, the values have different subscript letters assigned to them.

[†] Includes classroom activity, fighting, roughhousing, setting up/moving equipment, sitting, standing, and throwing rocks or snowballs.

[‡] Includes Auditorium/multipurpose, Bus loading area/School bus/public bus, Corridor/hall (excludes stairs), Doorway, Lunchroom/kitchen, Sidewalk/stairs/ramp/street/driveway/parking area, Restroom/lavatory.

[§] Includes basketball, football, soccer, and wrestling.

[‖] Includes baseball/softball, flag/touch football, gymnastics/tumbling, volleyball, and riding.

[¶] Includes running, weight lifting, track and field, dance, frisbee, and bicycling.

[#] Includes walking, playing on the bars (monkey bars/boy toy, etc.), climbing, dodge ball/war ball, kickball, jumping, sliding, swinging, sliding on ice, and four-square.

[**] Includes assembly, class change, class time (exclude P.E.), field trip, lunch, lunch recess, recess, and P.E. class.

[††] Includes school nurse, EMT on staff, or MD/ER/Healthcare provider/Hospital.