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Rodeo Catastrophic Injuries and Registry: Initial Retrospective and Prospective Report

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Objective: To introduce the Rodeo Catastrophic Injury Registry (RCIR) and quantify the nature and incidence of catastrophic injury and fatality in rodeo participants across North America.

Design: Retrospective and prospective collection of catastrophic and fatal injury data in rodeo using an online registry (RCIR).

Setting: Canada and the United States.

Participants: North American rodeo competitors.

Assessment of Risk Factors: Age, gender, level of competition, rodeo event, mechanism of injury, and use of protective equipment.

Main Outcome Measures: Frequency, incidence, and nature of catastrophic injuries and fatalities among rodeo participants.

Results: The incidence rate of catastrophic injury from 1989 to 2009 was 9.45 per 100 000 (49/518 286). The incidence rate of catastrophic injury during the 2007-2009 study period was 19.81 per 100 000 (19/95 892). The incidence rate of fatality from 1989 to 2009 was 4.05 per 100 000 (21/518 286). The incidence rate of fatality for the 2007-2009 study period was 7.29 per 100 000 (7/95 892).

Conclusions: Thoracic compression mechanisms of injury are most pervasive and likely to be fatal in rodeo and bull riding. It is unknown whether rodeo protective vests have a protective effect in reducing catastrophic and fatal injuries. On the contrary, helmet use in bull riding and rodeo events seems to have a protective effect in reducing both catastrophic injury and fatality.

Key Words: rodeo, bull riding, steer riding, catastrophic injury, fatality, helmet, vest, protective equipment, prevention

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INTRODUCTION

Rodeo and bull riding competitions are extremely popular spectator-supported sports in Canada, the United States, Brazil, Chile, Argentina, Australia, and New Zealand. Although rodeo can be seen as fun and entertaining, it is also a dangerous sport with high injury potential because of forces unseen in other sports.[1] Forces in rodeo result in common injuries, such as ligament sprains, muscle strains, fractures, joint subluxations and dislocations, and contusions.[2]

Concussions and other head injuries also constitute a major portion of injuries in rodeo, and are particularly experienced by bull riders during professional rodeo competition.[3,4] These injuries often occur because rodeo athletes are competing on or against animals weighing between 450 and 900 kg. Specifically, the highest injury rates occur during rough stock events (ie, bull riding, junior bull riding, steer riding, bareback riding, and saddle bronc riding).[1] Bull riding has an injury rate 2 times higher than any other major rodeo event (ie, 32.2 vs 14 per 1000 competitive exposures, respectively).[1] Comparison of bull riding injury rates with other contact sports confirms bull riding is the most dangerous organized sport in the world.[5] Ultimately, rodeo athletes are putting themselves at risk for injuries, including catastrophic injuries, which can leave them with permanent disabilities.

Catastrophic injuries are of particular interest to public health officials because these injuries are costly, are debilitating, and can be devastating to personal and family relationships.[6,7] It is important to use the study of catastrophic injuries for developing injury prevention strategies, which may decrease injury rates or the severity of injuries, and increase the quality of life of athletes. Currently, 2 major databases have been developed to study catastrophic injuries. The first was originally created in 1981 and is known as the "Canadian Ice Hockey Spinal Injuries Registry." It is now operated by Think First-Sport Smart and continues to collect and report on spinal cord injuries in hockey in Canada.[8] The second database is housed at the University of North Carolina and is known as the "National Center for Catastrophic Sport Injury Research" (NCCSIR).[9] The NCCSIR has the most comprehensive information on catastrophic injuries experienced by high school and collegiate athletes in the United States. Despite the risks and the increasing attention to catastrophic injuries in rodeo, no organization has collected such information industry wide. Therefore, a Rodeo Catastrophic Injury Registry (RCIR) for rodeo and bull riding was established at the University of Calgary. This article describes the results of the first 3 years of data collection (2007-2009) on rodeo and bull riding injuries.

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METHODS

Case Identification and Data Sources

The purpose of the RCIR was to identify descriptive catastrophic injury data both retrospectively and prospectively. Development of the RCIR began in January 2006, with completion of the registry in December 2006. Data collection began in January 2007. Ethics approval for this study was received and approved by the Conjoint Health Research Ethics Board at the University of Calgary. Information was collected using Web-based injury report forms created and designed using the database application StudyTRAX (ScienceTRAX, Macon, Georgia).[10] Injury report forms were used to gather information regarding specifics of the injury event, such as date, setting, environmental conditions, mechanism, severity, type, anatomical location, type and level of rodeo event participation, and use of protective equipment. Demographic information was also recorded.

Case reports were solicited from the following modes: media sources, rodeo personnel, general population, friends and family, caregivers, and fans. Case reports were entered either retrospectively, using memory recall, or prospectively, as cases occurred. Cases were identified and/or entered by patients, friends, relatives, medical personnel, allied health care professionals, rodeo fans, rodeo administrators, rodeo committee members, and media persons. Data were entered directly by these volunteers. Because data were collected in both a retrospective and prospective manners using the same Web-based questionnaire (RCIR), the data are presented as 1 questionnaire-based body of information.

Rodeo Catastrophic Injury Registry exposure was also generated through radio and television interviews and advertisements. Presentations were made to 3 rodeo and bull riding caregiver groups: the Justin Sportsmedicine Team (the United States), the rodeo medicine group of the International Professional Rodeo Association (the United States), and the Canadian Pro Rodeo Sport Medicine Team (Canada). These groups consisted of physicians, surgeons, athletic trainers, certified athletic therapists, physical therapists, chiropractors, and massage therapists who provided on-site injury care and management to professional rodeo and bull riding athletes in North America. Presentations were made to encourage case identification or entry and recommendations for Web site revision.

Injury Definitions

Data were entered by volunteers, but the injury definition—fatal, nonfatal, or serious—was confirmed by consensus agreement between the principal investigator and a coauthor. A third author was designated to arbitrate disagreements. Nonfatal injuries were defined as resulting in permanent functional disabilities, such as quadriplegia. Serious injuries were defined as those resulting in no permanent functional disability, such as a fractured cervical spine without permanent neurological dysfunction or skull fractures without residual brain dysfunction. Although musculoskeletal injuries are common in rodeo and bull riding participants, they were not the focus of this study.

Data Recruitment and Confirmation

Data collection occurred between January 2007 and December 2009. Duplicate cases were entered but easily identified using demographic information collected in the injury report forms. Duplicate forms were analyzed for consistency of details. Attempts were made to contact physicians or family members to clarify discrepancies. Each case was only represented once in this publication. Information that could not be ascertained defaulted to "unknown" categories.

Denominator and Injury Rate Calculation

Attempts were made to obtain annual numbers of registered rodeo competitors in North America for the past 10 years, or parts thereof, to provide a denominator that could be used to calculate injury rates. No comprehensive rodeo registry existed that could provide such data analogous to Hockey Canada's registry for registered nonprofessional ice hockey players, which was used to calculate spinal injury rates.[8] Therefore, a comprehensive search was made to identify professional, amateur, and high school rodeo associations throughout North America. Thirty-one associations were solicited to provide registration numbers. Some associations were unable or unwilling to provide such information. However, registration numbers were obtained from 12 associations. These included most of the largest rodeo associations in North America: the Professional Rodeo Cowboy Association, the sanctioning body of rodeo for the United States; the Canadian Professional Rodeo Association (CPRA), the sanctioning body of rodeo for Canada; the Professional Bull Riders, Inc; the National Intercollegiate Rodeo Association; the National High School Rodeo Association; and the National Little Britches Association. Although there was a possibility of duplicate registrations (ie, rodeo contestants competing in more than 1 association), and we are confident that we have accurate information from the largest rodeo associations in North America, there was an underestimation of the denominator resulting from incomplete access to data. Thus, the best study incidence denominator (2009) was 33 191 rodeo participants, whereas the average denominator for the 3-year study (2007-2009) was 31 964. Catastrophic injury rates are reported throughout as x per 100 000 to facilitate comparison with other reports.

RESULTS

Frequency and Incidence of Injuries

The Table presents descriptive data of 49 cases of catastrophic injuries that occurred between 1989 and 2009. Thirteen cases were collected prospectively using eyewitness accounts or patient self-reporting; 36 cases were collected retrospectively using patient or caregiver memory recall, patient interviews, and articles or news reports from Web sites or newspapers. All cases occurred in North America.

The incidence rate of catastrophic injury for the entire data collection period (1989-2009) was 9.45 per 100 000 (49/518 286). The incidence rate of catastrophic injury for the 3-year period (2007-2009) was 19.81 per 100 000 (19/95 892).

TABLE. Description of Cases From the Rodeo and Bull Riding Catastrophic Injury Registry (1989-2009) (n = 49)

Summative Data	Age <17 Years (Range, 9-17 Years)	Age ≥18 Years (Range, 18-49 Years)
Frequency of cases	13	36
Prospective	1	10
Retrospective	12	26
Sources of information		
Caregiver	1	13
Article/Web site/news report	10	13
Friend or relative	1	3
Self-report	1	4
Witness	—	3

The incidence rate of fatality over the entire study period (1989-2009) was 4.05 per 100 000 (21/518 286). The 3-year incidence rate of fatality during the study years 2007-2009 was 7.29 per 100 000 (7/95 892) participants.

Age and Gender

The mean age of competitors injured between 1989 and 2009 was 22 years, and the median was 21 (Table). The youngest case was 9 years old, whereas the oldest was 49 years old. Figure 1 shows that 13 of 49 (29%) catastrophic injuries occurred in competitors younger than 17 years, 8 of which were fatalities. Two fatalities were suffered by female competitors while barrel racing.

Fatalities (7 of 21) and catastrophic injuries (14 of 49) seemed to be biased toward an increased incidence rate in competitors aged 17 years or younger. This age group accounted for 33% of all fatalities and 28% of all catastrophic injuries in this database. Unfortunately, the current data available for the denominator is not rodeo event specific, and therefore, we were unable to compare age-related catastrophic or fatal injury rates.

Injury Severity

Type of Event

Figure 2 illustrates that rough stock event contestants constituted the majority (46 of 49) of cases reported in the RCIR. The greatest number of catastrophic injuries occurred during either bull riding or junior bull riding/steer riding events (38 of 49; 77.5%). This observation was maintained when injuries were classified according to severity (Figure 2). Four cases (8.2%) occurred during saddle bronc riding, and 3 (6.1%) during bareback riding. Several very uncommon mechanisms of injury were reported in this data set. A catastrophic injury occurred during tie-down roping when the

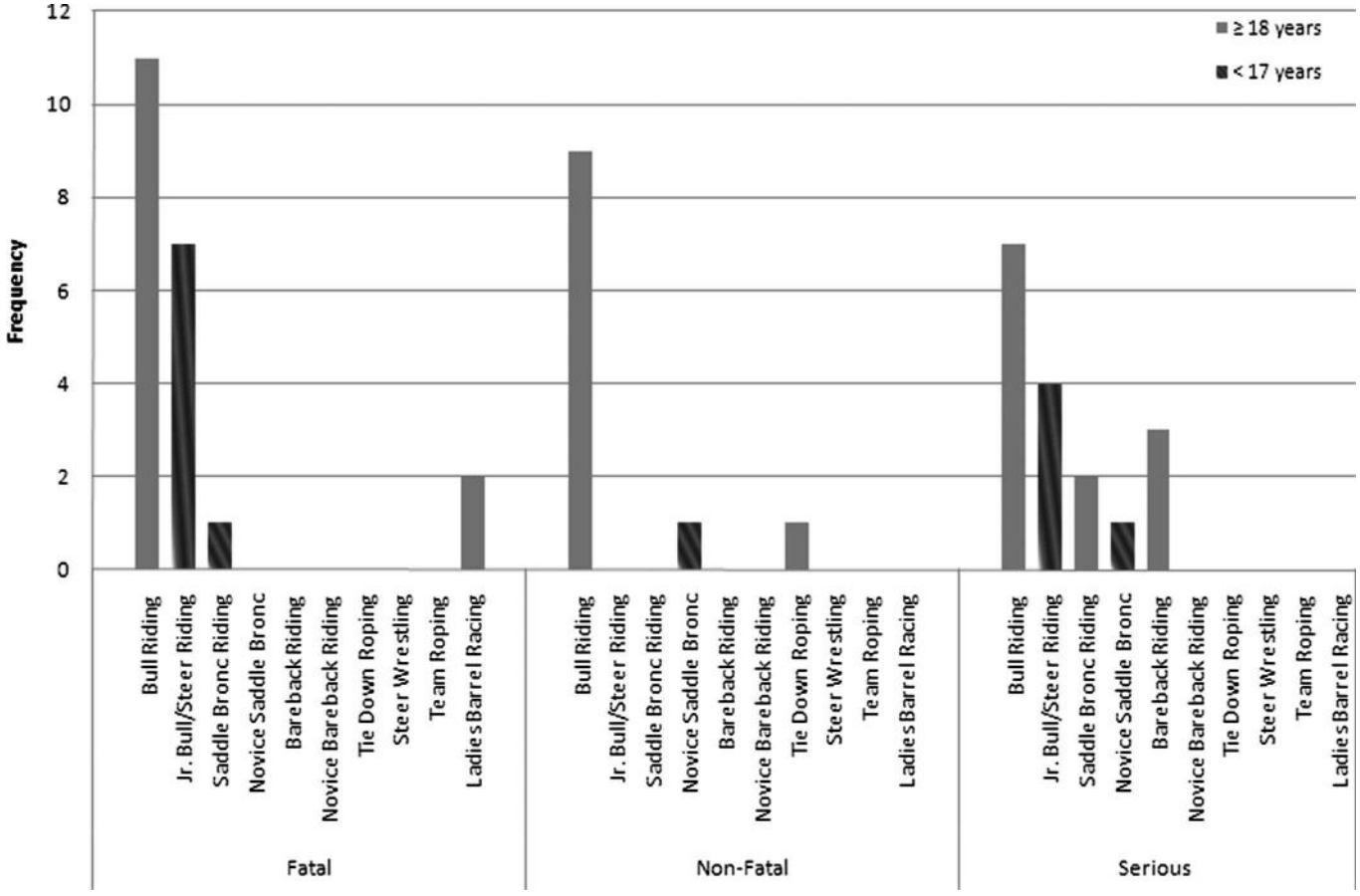

FIGURE 1. Distribution of injuries by severity, age, and rodeo event (1989-2009).

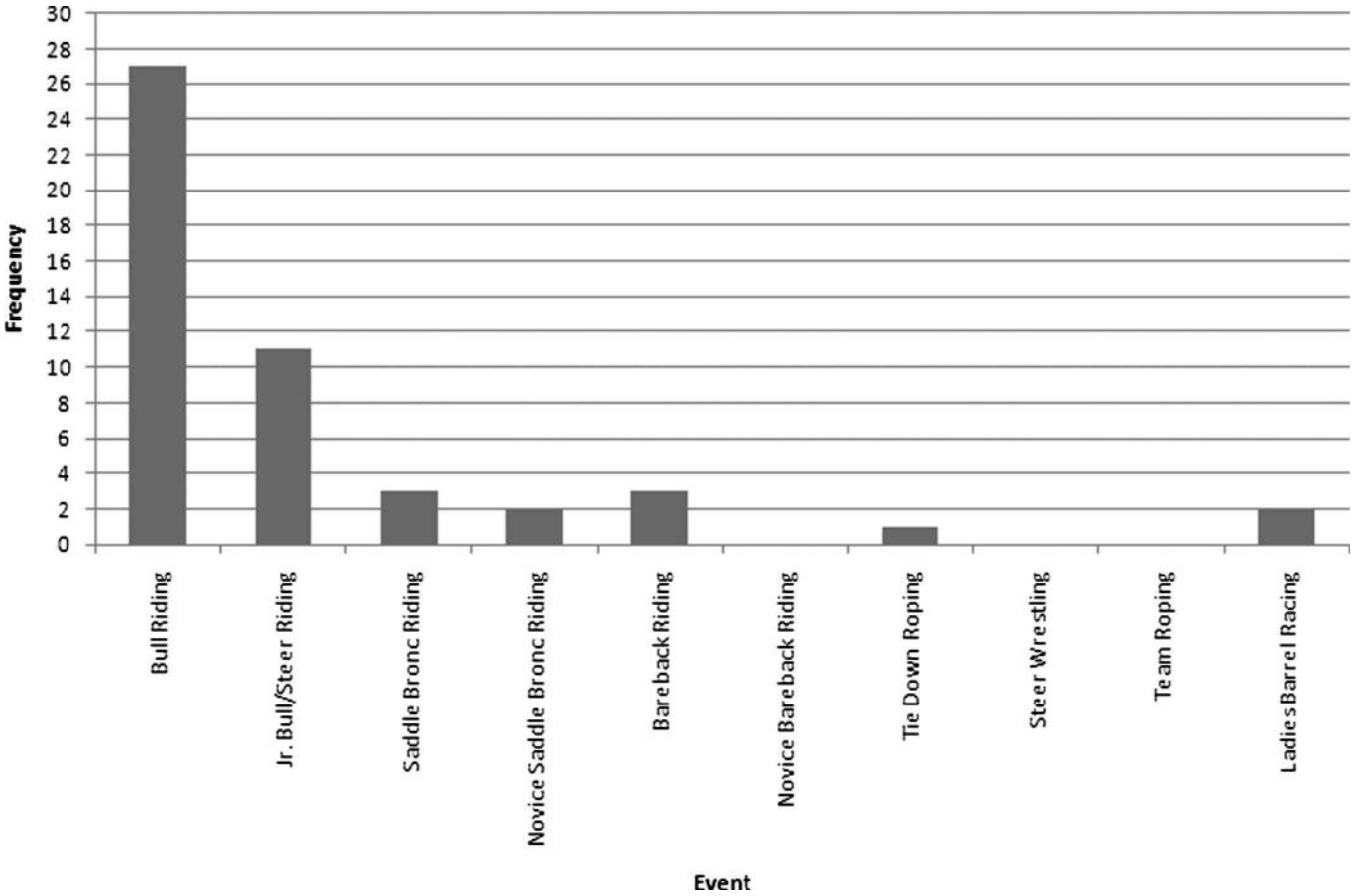

FIGURE 2. Distribution of injuries by rodeo event (1989-2009).

competitor stumbled while running to the calf, falling head first into the animal, resulting in cervical spine injury to the competitor. Two fatalities also occurred in barrel racing due to head injuries.

Mechanisms and Anatomical Location of Injury

Two general mechanisms of injury were identified in this initial report of findings of the RCIR. A combination of competitor and livestock was present in 70% of the catastrophic injuries reported, whereas the remainder involved contact between the competitor and the arena infrastructure. This was determined when competitors came in contact with the ground, chutes, walls, and arena or chute gates.

Figure 3 shows that among fatalities (n = 21), the most common mechanism (n = 12) was contact by the livestock with the chest, thorax, or abdomen of the competitor. Another group of accidents (n = 4) occurred when the athlete first suffered a head or facial injury, leaving him vulnerable to a subsequent fatal chest, thorax, or abdominal blow. Altogether, thoracic compression fatalities (n = 16; 76.19% of all fatalities) were a major mechanism of rodeo fatalities. Fatalities due to head or facial trauma were caused directly by livestock (n = 3; 14.28% of all fatalities) or directly with arena infrastructure (n = 2; 9.54% of all fatalities). Two of these head injury mechanism fatalities occurred to barrel racers with 1 fatality in each of bull riding, junior bull riding, and novice saddle bronc riding.

Fatalities and Protective Equipment

None of the rodeo contestants who suffered head injuries resulting in fatalities (n = 5) were recorded as wearing a helmet. All thoracic fatalities (n = 16) occurred in bull riding, junior bull riding, or steer riding. Eleven of 16 cases (69%) were known to have worn protective rodeo vests. Rodeo protective vests, helmets, and face masks were made mandatory equipment in the CPRA for boys' steer riding in 1994. Four fatalities resulting from thoracic compression injuries were reported as "vest wear unknown." Based on the age of 1 case (15 years) and the injury dates of 3 cases (range, 2002-2007), it was highly probable that these 4 contestants were equipped with rodeo vests. Only 1 case was definitely not wearing a vest.

DISCUSSION

The RCIR data indicated that high incidence rates of catastrophic and fatal injuries occur in rodeo and bull riding. This finding was not unexpected. Although substantial incidence rates of catastrophic injury to the head, face, and neck were presented, the highest incidence rates of catastrophic injury and of the fatality in rodeo and bull riding were

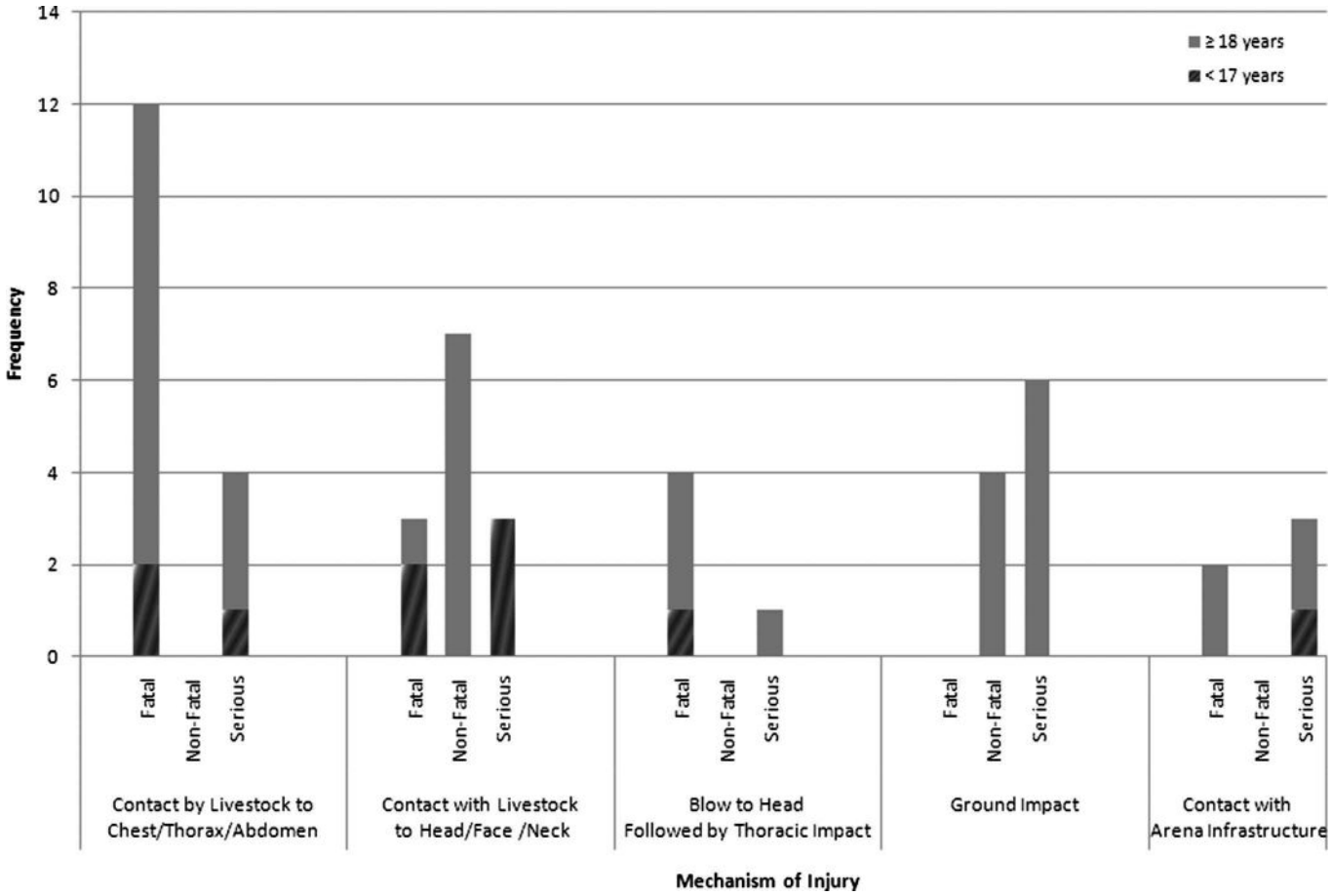

FIGURE 3. Mechanism and severity of injury in rodeo athletes (1989-2009).

found following mechanisms of injury that involved thoracic compression.

No reported cases of fatality due to head injury were documented when a helmet was worn during rodeo or bull riding events. Brandenburg and Archer[11,12] have shown that helmet use in bull riding diminished the incidence of head injury, facial fractures, and concussion, and in their questionnaire-based study, 97.5% of respondents answered "yes" to the question, "Has your Bull Tough helmet saved you from head injury?" Currently, bull riders and boys steer riders use helmets designed for a variety of sports, including lacrosse helmets, hockey helmets, and bull riding helmets. Although helmet-testing protocols have been developed for a rodeo-specific helmet,[13] the status of the Bull Tough helmet in that regard is currently unreported. Helmet use usually shows decreases in incidence and severity of injury, even in diverse sports, such as skiing, snowboarding, and cycling. Considering the facts, including that in our data no head injury fatalities occurred while the athlete was wearing a helmet, it is possible that wearing a helmet (eg, lacrosse, hockey, rodeo) may have a protective effect against head trauma fatality in rodeo events.

Thoracic compression was the most pervasive mechanism of injury and was most likely to result in fatality. Thoracic compression case data showed that 11 fatalities occurred with this mechanism of injury, when victims were recorded as wearing a rodeo protective vest. Four additional cases were reported as "unknown" regarding whether the victim wore a vest. However, based on the age of 1 victim (15 years) and the dates of injury of 3 victims between 2002 and 2007, it is highly probable that all contestants were equipped with rodeo vests.

Whether one accepts the thoracic compression fatalities as 11 of 16 confirmed to be wearing protective vests, or as 15 of 16 confirmed or 'likely' to be wearing vests, most fatalities occurred when the victims suffered thoracic compression while wearing protective rodeo vests. We encourage caution in interpreting the efficacy of rodeo protective vests. A confounding factor is that throughout the period of this data collection, vests were worn either by choice or by rule, thus the number of exposures to bull riders, junior bull riders, and boys steer riders would have been extremely small. These cases may illustrate the limitations of rodeo vests when the athlete is in a fixed body position, ie, positioned against a fixed object (the ground or a chute). Rodeo vests likely have a protective effect when the athlete is in a free body position. This occurs when the athlete's body is able to move following contact by the bull. We are currently unaware of any protocols or testing of rodeo protective vests, suggesting that more work remains to be done in understanding the effects of wearing vests in rodeo and bull riding events.

More work and international cooperation is also required to refine the denominator as event and age specific, as the next

3-year report will be compiled in 2013. If we are able to convince more rodeo and bull riding associations to contribute accurate demographic and event-specific information, data will increase in accuracy and in interpretive value.

Limitations

Despite efforts to inform the rodeo public about the purpose, merits, and existence of the RCIR, it is most likely that our data underreported both catastrophic injury and fatalities in bull riding and rodeo athletes. We also acknowledge that the denominator is currently incomplete; however, it is the best estimate of bull riding and rodeo participation rates that we have been able to develop to date. The Canadian Ice Hockey Spinal Injury Registry first began in 1981,[14] but additional information regarding early cases was added in subsequent publications.[8] Likewise, as awareness of the RCIR and knowledge of the purpose of reducing catastrophic injury and fatality in bull riding and rodeo becomes broadly known, greater denominator access, cooperation, and accuracy may be attained over time.

Data entry in the RCIR occurred when those interested in the industry took the time to submit cases. The voluntary nature of data collection was acknowledged as a limitation. This limitation was mitigated by cooperation from devoted health care providers and leaders in rodeo injury care throughout North America. It was further mitigated by semi-annual Web-based searches completed by a coauthor (B.L.).

CONCLUSIONS

Accurate data collection, either retrospectively or prospectively, in a sport without central or international administrative structures is a challenge. We must establish organizational relationships to facilitate accurate denominator and demographic information. Refinements in case-based data collection will facilitate more complete data collection, supporting the goal of catastrophic and fatal injury prevention. Thus, data collection innovation and further research are essential to achieving catastrophic and fatal injury rate and frequency reduction strategies in rodeo and bull riding events.

Additional research is required to study the effects of rodeo protective equipment. The greatest risk of catastrophic or fatal injury in bull riding is to the thorax.

It is currently unknown whether rodeo protective vests have a protective effect in reducing catastrophic injury or fatality in bull riding, boys steer riding, or junior bull riding. However, helmet use in bull riding and rodeo events seems to have a protective effect in reducing both catastrophic injury and fatality.

RECOMMENDATIONS

Refinement of the current RCIR, greater participation in catastrophic and fatal injury reporting within the bull riding and rodeo industries, and development of a stronger injury prevention culture are desirable. Supporting industry-wide initiatives aimed at defining the challenges and finding industry-acceptable solutions will strengthen the potential to reduce these catastrophic and fatal injuries.

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