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Epidemiologic Analysis of Injury in Five Years of Canadian Professional Rodeo

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ABSTRACT

Longitudinal studies of rodeo injuries are rare. We prospectively investigated injuries in professional rodeo in Canada over a 5-year period. Our specific interests included injury incidence density in specific rodeo events, risk factors such as past injury, and the incidence of head injury. Of 323 professional rodeos from 1995 through 1999, 63 rodeos provided a convenience sample. These rodeos were selected because the Canadian Professional Rodeo Sport Medicine Team was in attendance at these events, thus providing both competitor health care and data collection. Four hundred fifty-one injuries were reported during 30,564 competitor-exposures. The greatest injury frequency and injury incidence density were in the rough stock events (bull riding, bareback riding, and saddle bronc). Bull riding accounted for the greatest injury frequency (141) and incidence density (32.2 injuries per 1000 competitor-exposures). Bull riding had a relative injury risk of 1.32 when compared with bareback riding; bareback riding had a relative injury risk of 1.39 when compared with saddle bronc riding. Concussions accounted for 8.6% of all reported injuries. Concussions and other head injuries (65) were second only to knee injuries (76) in frequency of injury to specific body parts. This concussion frequency is higher than has previously been reported.

The combination of large untamed animals, steel gates and chutes, young athletes, Western heritage and culture, and the potential for financial gain and world champion

status, all present in professional rodeo, create a very exciting sport with injury potential that includes forces that are not seen in other sports. There have been impressions among the public that injury is rampant, serious, and life threatening in rodeo competitors. Recent reports on rodeo injuries include data on the danger of the rough stock events,⁷ such as a description of aortic rupture caused by being thrown from a bull.¹² Higher injury rates have been reported for children and youth than in adults in rodeo,^{1,2} leading to a call for testing and increased use of protective equipment.² There has even been recognition that the fad of riding mechanical bulls has caused injury to participants.⁹ Finally, there has been a concern that the depth of epidemiologic knowledge that exists for traditional sports injuries remains nonexistent for rodeo activities.⁷

The purpose of this 5-year prospective study was to assess injury incidence density in specific rodeo events, assess risk factors such as past injury in professional rodeo, and to clarify the incidence of head injury in professional rodeo.

MATERIALS AND METHODS

Samples

The 1995 through 1999 Canadian professional rodeo seasons consisted of 323 professional rodeos. Sixty-three rodeos attended by the services of the Canadian Professional Rodeo Sport Medicine Team (CPRSMT) provided a convenience sample. (Sponsorship changes have stimulated the creation of the CPRSMT, a not-for-profit society that consists of the same leadership and mission as presented in an earlier study³ but with a different name.) As discussed in our previous study,³ the presence of the CPRSMT was the mechanism by which data were collected. The selection of rodeos was based on a combination of factors, the most important factors being the number of competitors participating and the amount of prize money available,

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with higher monetary amounts attracting the highest caliber of competitors. The sample of 63 rodeos in this study included 10 of the top 12 Canadian rodeos in terms of the prize money available to winning competitors for each of the 5 years studied. This sample of rodeos represents 19.5% of all Canadian professional rodeos or 30.8% of all Canadian professional rodeo performances during the study period. Both rodeos and rodeo performances are noted since not all rodeos have the same number of performances (individual rodeos have a range of 2 to 10 performances). One rodeo performance is a group of rodeo events consisting of approximately 10 competitors in each event that collectively occur in the same setting and in a 2- to 4-hour period. This sample included a cross-section of indoor and outdoor rodeos, large and small rodeos, and rodeos occurring throughout the professional rodeo season.

Competitors included the world's best rodeo competitors from Australia, Brazil, New Zealand, the United States, and Canada. All livestock were provided by stock contractors sanctioned by the Canadian Professional Rodeo Association. The investigation protocol met the standards of the University of Calgary Conjoint Medical Research Ethics Board.

A previously described instrument and methods³ were used to assess the frequency and rate of injury in specific rodeo events and to assess the rate of reinjury to specific body parts. Records were collected by the CPRSMT through therapist-competitor interactions. These interactions were either prompted by competitors voluntarily seeking injury assessment and management or as a result of traumatic injury that required immediate attention in the rodeo arena. Inclusion criteria required that the injury must have occurred in a registered competitor at a Canadian professional rodeo at which the CPRSMT was officially present and providing service. Injuries that occurred in competitors of the major rodeo events (bull riding, bareback, saddle bronc, steer wrestling, calf roping, and ladies barrel racing) and minor rodeo events (wild horse racing, novice bareback, novice saddle bronc, boys steer riding, wild cow milking, and team roping) were recorded.

Concussion was included as a reportable injury and was specifically defined as a traumatically induced alteration in mental status with or without loss of consciousness.¹³ For the purpose of this investigation, concussions were graded according to the American Academy of Neurology classification of concussions.¹³ Head injuries with signs and symptoms lasting less than 15 minutes are grade I concussions, those with signs and symptoms lasting more than 15 minutes are grade II concussions, and any loss of consciousness signifies a grade III concussion.

Competitor injury data were excluded when the injury occurred at a nonsampled rodeo, at a practice session, or when the original cause of injury was unknown. There were six incidents of exclusion because of insufficient data collected by the therapist, and one entire set of data from one rodeo (Innisfail, 1998) was lost. The exclusion criteria were applied equally to relatively simple injuries such as sprained ankles and to much more serious injuries requir-

ing surgical intervention, such as ACL ruptures, muscle tendon ruptures, and fractures.

Exposure

Exposure data were compiled by rodeo event with the permission and assistance of the Canadian Professional Rodeo Association. Records were kept of the exact number of competitors in each event at each professional rodeo. One competitor-exposure was defined as each time that one competitor competed (attempted) in one event at a rodeo (for example, one bull ride). This is the same definition established in our earlier report.³

In selected events there are teams of competitors, such as in steer wrestling, wild cow milking, and wild horse racing. One team member in the steer wrestling event rides his horse to help control the running path of the steer. Although it is technically possible for this teammate (the hazer) to be injured, this teammate is very rarely injured, and so this participation was not counted as a competitor-exposure. Conversely, the two members of the wild cow milking team and the three members of the wild horse racing team are all frequently exposed to injury, and thus the competitor-exposure figures for these events include each team member.

Analysis

Data were entered on a spreadsheet using Microsoft Excel (Microsoft Corp., Redmond, Washington) for descriptive analysis. Analyses were grouped by rodeo event, injury type, and rodeo location. The focus of the analysis was injury and risk in the six major rodeo events (bareback, saddle bronc, steer wrestling, calf roping, ladies' barrel racing, and bull riding). New injuries reported in the "other" category included injuries to team ropers, wild cow milkers, wild horse racers, novice saddle bronc riders, novice bareback riders, boy steer riders, bull fighters, clowns, pick up men, and other rodeo personnel present in the arena. The analysis includes reporting of incidence density (the number of injuries per 1000 competitor-exposures) for each rodeo event as well as rate ratios. Injury was categorized as minor (first or second degree sprains/strains, contusions), severe (fractures, concussions, third degree sprains/strains, and subluxations/dislocations), and other (wounds, overuse conditions, and miscellaneous). The risk of reinjury to competitors was examined by reviewing the data of all competitors who suffered more than one injury over 5 years. These competitors were identified as multiple injury victims. Injuries that occurred when competitors suffered injury to more than one body part in one competitor-exposure were each recorded as separate injuries. Competitors who had more than one body part injured in one competitor-exposure and competitors who suffered completely different injuries during the study were classified in the multiple injury category. In the multiple injury category, those competitors who suffered a subsequent injury to the same body part or to the same extremity were classified as reinjured.

TABLE 1
Injury Incidence Density Comparisons for Major Rodeo Events

Type	Event	Injury frequency	Competitor-exposures	Incidence density ^a	Rate ratio ^b	95% CI ^c
Rough stock	Bull riding	141	4375	32.2	3.39	(2.46–4.67)
	Bareback	72	2938	24.5	2.60	(1.81–3.72)
	Saddle bronc	63	3599	17.5	1.89	(1.31–2.74)
Timed events	Steer wrestling	50	5386	9.2	1.0	
	Calf roping	8	4438	1.8	0.19	(0.09–0.41)
	Ladies barrel racing	6	3959	1.5	0.16	(0.07–0.38)
	Other	111	5605			

^a Number of injuries per 1000 competitor-exposures.

^b Ratio compared with steer wrestling.

^c 95% confidence interval.

RESULTS

A total of 451 injuries was reported in 30,564 competitor-exposures, yielding an overall rodeo competitor injury rate of 14.7 injuries per 1000 competitor-exposures. Individual event injury and exposure data are provided in Table 1. Bull riding accounted for 141 of 451 injuries, or 31% of all rodeo injuries, whereas each of the other rough stock events (steer wrestling, saddle bronc, and bareback) accounted for 11% to 16% of all rodeo injuries.

Injury Rate and Relative Risk

Rate ratios and 95% confidence limits were calculated using Stata Release 6.0 software (Stata Corp., College Station, Texas) with the cohort study "immediate" command. The baseline for comparison was assigned to steer wrestling, because it had a modest injury rate of 9.2 per 1000 competitor-exposures and is considered to be a major event. Table 1 shows that there were significantly higher injury rates and relative risk in bull riding, bareback, and saddle bronc events than in steer wrestling. Among the major events in professional rodeo, bull riding was associated with the highest incidence of injury and the highest relative risk compared with steer wrestling. Bareback riding was associated with the second highest injury rate among major rodeo events.

The difference in the relative risk of injury between bareback riders and bull riders was not significant (rate ratio, 1.32; 95% confidence interval, 0.99 to 1.74), nor was the difference in relative risk of injury between the bareback and the saddle bronc event (rate ratio, 1.39; 95% confidence interval, 1.00 to 1.96). However, there was a significant difference in the relative risk between saddle bronc riders and bull riders (rate ratio, 1.84; 95% confidence interval, 1.37 to 2.47) and between wild horse racers and bull riders (rate ratio, 0.61; 95% confidence interval, 0.43 to 0.86).

Injury Type and Incidence

The most frequent sites of injury for all professional rodeo competitors during 60 professional rodeos in Canada from 1995 to 1999 are presented in Figure 1. Knee injuries occurred approximately twice as often as shoulder injuries

and concussions. Other body parts were injured with frequencies ranging from 1 to 28 occurrences.

The types of injury and the status of the injury (new, multiple, or reinjury) are shown in Table 2. Multiple injuries accounted for 17% of all injuries, whereas reinjuries accounted for less than 5% of all injuries. Minor sprains and strains and contusions constituted one-half of all injuries.

Concussions occurred in rodeo competitors 39 times during this 5-year period (10 grade I, 15 grade II, 12 grade III, and 2 concussions that were not graded because patients were transported by emergency medical service personnel and therefore lost to follow-up). Bull riders sustained 15 concussions, bareback riders sustained 10 concussions, and saddle bronc riders sustained 5 concussions. The remaining nine concussions were evenly distributed among other major and minor rodeo events. Only one competitor (a bull rider) sustained two concussions in this series. Individual mechanisms of concussion injury are shown in Figure 2.

Reinjury and Multiple Injury

Records of 100 competitors who sustained more than one injury of any type over the 5-year period were examined,

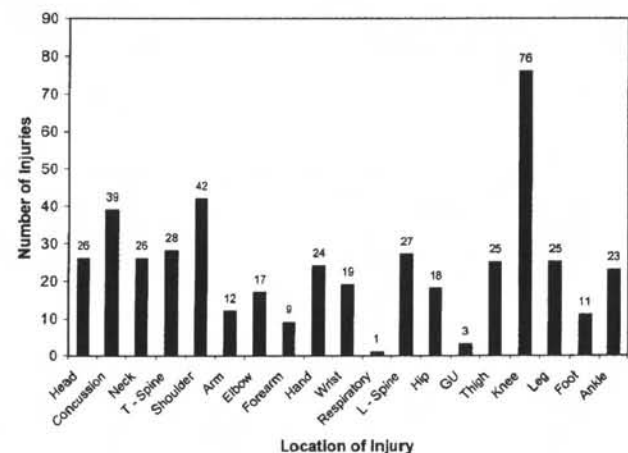


Figure 1. Frequency of injuries per body part in 5 years of professional rodeo in Canada.

TABLE 2
New Injury, Multiple Injury, and Reinjury by Injury Type in 5 Years of Professional Rodeo in Canada

Severity	Injury type	New injury	Multiple injury	Reinjury	Total
Minor	Sprain/strain (first or second degree)	98	21	8	127
	Contusions	79	17	3	99
Serious	Fractures	34	13	3	50
	Concussion	30	7	2	39
	Sprain/strain (third degree)	23	6	3	32
Other	Subluxation/dislocation	20	2	0	22
	Wounds	17	4	1	22
	Overuse conditions	11	2	1	14
	Miscellaneous	39	6	1	46
	Total	351	78	22	451

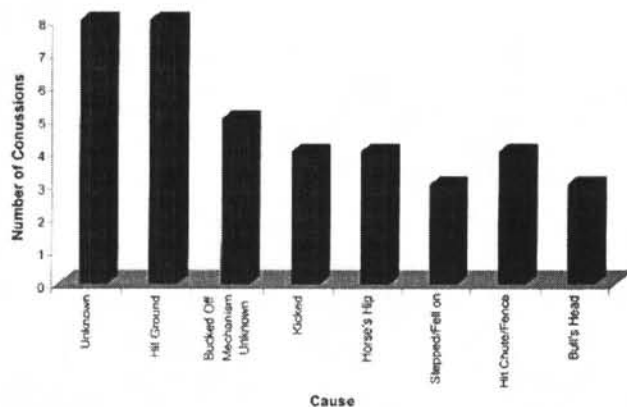


Figure 2. Mechanisms of injury causing concussion in 5 years of professional rodeo in Canada.

and these competitors were then classified into either a reinjury or a multiple injury group. Reinjury (22 of 100 competitors) was defined as a competitor sustaining more than one incident of injury to the same body part or extremity. For example, if a bareback rider injured his elbow, subsequent injury to the ipsilateral shoulder, elbow, wrist, or hand was reported as injury to the same extremity complex. The multiple injury group (78 of 100 competitors) consisted of all other competitors who sustained more than one injury during the study.

The 78 competitors who sustained multiple injuries over the 5-year period accounted for 17.2% (78 of 451) of all injuries. The reinjury group consisted of 20 competitors who injured the same body part (8) or the same extremity complex (14). One competitor was recorded as having two reinjuries to the same extremity, and one competitor had a reinjury to the upper extremity complex and a reinjury to the lower extremity complex; thus the total number of reinjuries in Table 2 is 22. One competitor who suffered reinjury had a second concussion as his reinjury while another had a nasal fracture and a concussion in separate exposures.

Reinjury alone constituted only 4.8% of the total number of injuries (22 of 451). Table 2 shows that 28% of all injuries were grade 1 or 2 sprains, 22% were contusions, and 11% were fractures. Table 2 also shows that reinjury constituted a small proportion of each injury type. Consequently, these findings do not support the speculation that

reinjury is the most common type of injury in rodeo competitors.

DISCUSSION

Injury Rates and Risk

The overall injury rate (14.7 injuries per 1000 competitor-exposures) over the 5-year course of this prospective study of Canadian professional rodeo competitors compares favorably with the overall injury rate we reported previously (23.0 injuries per 1000 competitor-exposures).³ Individual event data support the impression that both bareback (24.5 injuries per 1000 competitor-exposures) and bull riding (32.2 injuries per 1000 competitor-exposures) event participants have high injury rates,⁶ with bull riding injuries accounting for 31% of all injuries in this series. One "minor" event in rodeo, the wild horse race, accounted for the very highest incidence density (53.0 injuries per 1000 competitor-exposures), and this incidence density differed significantly from that found in bull riders. The incidence density data for bull riding are almost identical to that of our earlier 1-year prospective study (36.0 injuries per 1000 competitor-exposures), but the bareback riding incidence density was reported earlier as 46.0 injuries per 1000 competitor-exposures. The reason for the different bareback riding incidence density rate in the earlier study may be a function of the length of the study period.

Some generalizations can be made from these 5-year data. First, of the major rodeo events, bull riding accounts for the greatest injury rate. The injury rates for other rough stock events are all similar, but are modest when compared with the rate for bull riding. The second most injurious rough stock rodeo event is bareback riding. Bareback riders had a lower rate of injury than bull riders, but they had a higher rate compared with saddle bronc or steer wrestling competitors. Finally, the calf roping and ladies barrel racing events had very low injury rates. These findings are similar to those of previous reports.^{3,5-7}

Injury Type and Body Part Injured

The measurement or assessment of injury severity in professional rodeo has several limitations. The use of time loss as a severity indicator is currently not feasible be-

cause the competitors compete year round, all over North America. Often one cowboy will compete in four or five different rodeos in the same number of days. Because there is no central medical authority, and cowboys participate in more than 800 rodeos located in 43 states and 4 provinces, tracking the injured athlete is problematic. Consequently, it is not possible to accurately determine the return to participation after injury. Injury data in Table 2 have been grouped in an attempt to demonstrate the type of significant injury to the rodeo contestant. However, some very serious injuries (such as pneumothorax and an injury in which a horn punctured about 5 inches into a competitor's axilla) are reported as miscellaneous injuries.

First or second degree sprains and strains accounted for 28.5% of all injuries. Serious injury is conservatively estimated as accounting for approximately 30% of all injuries and consisted of rupture of ligaments or tendons (7%), fractures (11%), concussions (8.6%), and subluxations or dislocations (4.8%).

Fortunately, approximately one-half of all rodeo competitor injuries in this study were minor sprains, strains, and contusions. Wounds can be dramatic in professional rodeo, but they only account for 5% of the injury total. Degenerative or overuse conditions and chronic injuries (such as tendinitis) accounted for only 3.1% of all injuries reported by these athletes.

Over the 5-year period of this study, there were 23 (5.5%) ankle injuries. Griffen et al.,⁴ in 1983, speculated that cowboy boots provide some protection against ankle injury in rodeo. In their original study and in a subsequent investigation in 1987,⁵ they found no ankle injuries. The fact that our investigation included approximately 25-fold more rodeo performances likely accounts for the difference in findings. Slawski and West¹⁰ reported on five cases of serious ankle injuries in bull riders. In our series there were three ankle fractures during a 10-day period. We conclude that ankle injuries do occur regularly in professional cowboys, despite any potential protective effect of cowboy footwear.

Concussions

Meyers et al.⁷ reported only 2 concussions in a series of 61 injuries that occurred during a 3-day, 7-event rodeo. Our 5-year prospective study identified a much higher proportion of head injuries than was reported in our original epidemiologic study,³ or in a previous 10-year epidemiologic study.⁶ There was a total of 39 concussions reported over the study period, 12 of which were grade III. Concussions accounted for 8.6% of all injuries recorded, second only to shoulder injuries and knee injuries. There are a number of possible explanations for this increase in occurrence or reporting of concussions. Despite having almost identical staff providing service and recording data, it may be that there is an increased awareness of head injury in rodeo,^{1,2} as well as in sports in general, which may have led to an increase in the reporting of concussions. There is also a widespread belief that now a greater percentage of the stock contractors' herds is of high quality bucking

stock,¹¹ which could affect the head injury rate in bull riding, bareback riding, and saddle bronc riding events. The reporting of head injury rates, risk, and severity warrants further attention. Although the prevention of head injuries is the ultimate goal, evidence from this investigation may be strong enough to prompt research regarding the use of existing head-protective equipment such as hockey or lacrosse helmets and facemasks in professional rodeo. We are currently unaware of any testing of head-protective devices specifically for the forces involved in rodeo.

It is possible that a competitor's bareback riding style may be related to the incidence of concussion in the cases where the competitor's head hits the horse's hip while the competitor is in his desired position. Some bareback riders ride relatively upright, while others lie back along the horse's back. Unfortunately, the question of how a rider seats himself during bareback competition was not asked prospectively. Thus, whether the riding style influences the concussion rate in this event remains a matter of speculation.

Figure 2 shows that it is common for the cause of concussion in rodeo to remain unknown. This may be because it is often unclear at what point the competitor becomes concussed or loses consciousness. For example, in bareback riding, violent whiplash mechanisms may actually cause a loss of consciousness, but it is not always possible to determine with confidence whether the whiplash or the impact with the horse's hip caused the loss of consciousness, even when the event is witnessed by members of the medical team. In addition, some episodes go without witness by medical team members, who are fulfilling other roles, and there are also some injury histories without mechanism of injury records because the recorders were focusing on signs, symptoms, and management.

The injury mechanisms shown in Figure 2 are almost identical to those reported by Griffen et al.⁵ and are reported here in the hope that future investigations may clarify the most common causes. This may, in turn, help in the estimation or measurement of the involved forces, with the ultimate goal of appropriate equipment design and injury reduction hypothesis testing. There has been at least one incident in which a cowboy wearing a lacrosse-style helmet and facemask was hit by the bull's head and suffered severe head and facial injuries despite the protective equipment. Other factors that may have a protective effect in limiting head injury in rodeo competitors include the use of mouthguards, core and neck stability programs, identification of a history of head injuries, and, possibly, rule changes to limit or monitor repeated exposure after injury.

Reinjury and Risk

Reinjury in rough stock events is a risk factor that has not been described epidemiologically until this study. Reinjury in rodeo athletes was reported as a concern, with no data presented, by Nebergall.⁸ Our small number of competitors who suffered multiple injuries accounted for a total of 17.2% of all injuries (78 of 451). Of this group of

athletes, reinjury of the same body part (10.3%) or extremity (15.4%) accounted for about one-fourth of all athletes who suffered more than one injury over the 5-year study. However, reinjury episodes accounted for only 4.8% of the total number of injuries recorded. Therefore, this information should be interpreted with care.

Limitations

Presently, there is no mechanism for tracking time loss in professional rodeo. The time between injury onset and return to competition may be influenced by factors other than injury severity. In addition, injuries that ordinarily require time off from sports, such as fractures, may not keep a rodeo competitor out of competition, despite the fact that a fracture would normally be considered a serious injury with standard time loss definitions. This highlights the fact that the return to competition is sport-specific. For example, a stable fracture to a metatarsal, or to the "free hand," in a rough stock competitor, may not limit competition exposure. The definition of injury that we have selected does not easily lend itself to the measurement of injury severity. Lack of an accepted definition of serious injury in rodeo remains a limitation of epidemiologic rodeo information.

The use of different data collectors, despite team vigilance and voluntary injury reporting, remains as a limitation. Most likely, the use of different data collectors results in an underestimation of the frequency of injury and, therefore, event-specific risks in professional rodeo may also be underestimated. It is unlikely that underreporting of injuries is tied to specific rodeo events, since our medical team, having been involved in rodeo care for the past 17 years, is well known to all event competitors. It is also unlikely that information bias has influenced these results; our staff are experienced sports medicine professionals with both rodeo experience and experience in injury classification.

CONCLUSIONS

The most noteworthy finding of this 5-year prospective study is that concussions were reported more frequently than in other reports of rodeo injury. Fifteen of the competitors in this study who sustained concussions suffered

a loss of consciousness. Other major findings are that bull riding has the highest injury incidence density (32.2 injuries per 1000 competitor-exposures) of the rough stock rodeo events and that the bareback riding injury incidence density is not significantly different from that of bull riding. Reinjury among professional rodeo competitors constituted less than 5% of all injuries reported and, thus, the perception that reinjury in professional rodeo is a concern has not been supported.

The knowledge gained from this study gives us confidence in the description of rodeo injury rates, severity, reinjury, and risk. Attention should now be turned to the assessment of preventive/protective equipment, interventions, and strategies to effect change in injury incidence and severity in professional rodeo.

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