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Jockey Falls, Injuries, and Fatalities Associated With Thoroughbred and Quarter Horse Racing in California, 2007-2011

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Background: Despite the popularity of the horse racing industry in the United States and the wide recognition that horse racing is one of the most hazardous occupations, little focused research into the prevention of falls by and injuries to jockeys has been conducted.

Purpose: To describe the incidence rates and characteristics of falls and injuries to Thoroughbred and Quarter Horse racing jockeys in the state of California.

Study Design: Descriptive epidemiology study.

Methods: Data on race-day falls and injuries were extracted from jockey accident reports submitted to the California Horse Racing Board from January 2007 to December 2011. Denominator data, number of jockey race rides, were obtained from commercial and industry databases. Jockey fall, injury, and fatality incidence rates and ratios in Thoroughbred and Quarter Horse flat races were estimated using Poisson regression. Characteristics of falls and injuries are described and compared.

Results: In Thoroughbred races, 184 jockey injuries occurred from 360 reported jockey falls, 180,646 race rides, 23,500 races, and 3350 race meetings. In Quarter Horse races, 85 jockey injuries occurred from 145 jockey falls, 46,106 race rides, 6320 races, and 1053 race meetings. Jockey falls occurred at a rate of 1.99 falls per 1000 rides in Thoroughbred races, with 51% of falls resulting in jockey injury, and 3.14 falls per 1000 rides in Quarter Horse races, with 59% of falls resulting in jockey injury. The majority of falls occurred during a race, with catastrophic injury or sudden death of the horse reported as the most common cause in both Thoroughbred (29%) and Quarter Horse (44%) races. During the period studied, 1 jockey fatality resulted from a fall. Jockey fall rates were lower but injury rates were comparable to those reported internationally.

Conclusion: On average, a licensed jockey in California can expect to have a fall every 502 rides in Thoroughbred races and every 318 rides in Quarter Horse races. While jockey fall rates were lower, injury rates were similar to those in other racing jurisdictions. The high proportion of jockey falls caused by horse fatalities should be further investigated.

Keywords: epidemiology; incidence; injury; jockey; horse; falls

Horse racing has been conducted in the state of California since the 1800s and currently represents approximately 9% of flat races held in the United States (US). In the 2010-2011 fiscal year, California had 12 racetracks, with

40,070 horse starts and horses vying for almost US\$140 million in purses.⁴ However, riding racehorses is one of the most hazardous occupations,¹¹ with the majority of injuries to jockeys caused by falls.^{5,7,8,12,14,15,22,24} Internationally, jockey falls have been reported to occur at a rate of 3 to 4 falls per 1000 race rides, with 27% to 44% resulting in injury.^{8,11,12,22} Of the jockey injuries caused by falls, soft tissue injuries occur most frequently^{12,22,25}; but for more serious injuries, including those that are career ending, require time off from work, or result in an insurance claim, fractures are more common.^{2,5,7,12,15,20,22} Typically, jockeys most frequently sustain injuries to the lower limbs (range, 18%-25%),^{5,7,20,24} followed by injuries to the face, head, and neck (range, 16%-21%)^{5,7,20,24}; shoulder (range, 17%-18%)^{5,7}; upper limb (15%)^{5,7}; and back (range, 9%-14%).^{5,7,24} Previous studies have described injuries in detail; however, further research into the prevention of jockey falls and associated injuries is needed.

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International studies have compared incidence rates for jockey falls, injuries, and fatalities in Thoroughbred (TB) racing,^{3,7,8,11,12,14,22} but comparisons with US findings^{15,24,25} have not been possible because US race ride incidence rates were not reported. Additionally, although TBs represent the primary breed of racehorse internationally, Quarter Horse (QH) racing is an important part of racing but is not common outside the US. Therefore, the objectives of this study were to determine the incidence and characteristics of jockey falls, injuries, and fatalities that occurred at TB and QH race meetings in California during the 2007-2011 racing seasons and to compare the TB jockey fall incidence rates in California with those in other countries.

METHODS

The University of California–Davis Institutional Review Board (IRB) waived the need for review.

Sources of Data

Incident data on falls from horses by jockeys riding in races during race meetings held in California were collated from jockey accident reports submitted to the California Horse Racing Board (CHRB) by racetrack stewards from January 1, 2007, to December 31, 2011. The CHRB required an accident report for all on-track accidents involving jockeys. Only accidents that involved a jockey falling or being dislodged from a horse in association with a race were studied.

Fall, injury, and fatality numbers and rates from other countries were sourced from previous studies. Similar to this study, an Australian study collated information from stewards' reports that documented falls that occurred on race day,¹¹ whereas European studies collated medical evaluations of falls (United Kingdom,^{12,22} Ireland,^{12,22} and France¹²). The data source for the study from Japan was not reported.¹⁴ Jockey mortality data were obtained from the US Jockeys' Guild for the US, Canada, and Mexico (1940-2012).

Denominator data, including the number of horse races, race days, and jockey race rides, were obtained for TB¹⁹ and QH¹ races for race meets held in California, from January 1, 2007, to December 31, 2011.

The time and cause of fall and jockey outcome were categorized. Time of jockey fall relative to race events was categorized as pre-, during-, or post-race. Pre-race falls occurred in the paddock, during the post parade (the procession in front of the grandstand and warm-up), or in the starting gate. During-race falls occurred from the jockey leaving the starting gate to passing the finish line. Post-race falls occurred after the finish line. Cause of jockey fall was categorized as "catastrophic injury or sudden death of the horse," "horse behavior," "horse clipped heels," "hampered by fallen horse/rider," "horse shifted ground abruptly or ducked in," "horse stumbled," or "other." Jockey outcome was categorized as "injured" or "uninjured." The jockey was considered injured if noted by the race-day stewards as having a substantive injury that precluded them from riding, being declared unfit to ride, or being transported to a hospital as a result of a fall. Assessments of injury by a medical

professional, including injury type and body part involved, were not available.

Statistical Analysis

Incidence rates were expressed as the number of jockey falls or jockey injuries per 1000 race rides. Fatality incidence rates were presented as the number of jockey deaths per 100,000,000 race rides. Incidence rate ratios (IRRs), with 95% confidence intervals (CIs), were estimated using Poisson regression. Poisson regression was used to compare jockey fall and injury rates between TB and QH races, between data reported from other countries in TB races and that from the current study, and to model the mortality data. A linear term, using rank scores, was used to estimate trends in annual incidence rates.

Descriptive statistics of falls and injuries are presented. Time of injury, cause of injury, and injury outcome were compared between the type of race (TB vs QH) using the Pearson χ^2 test and the Cochran-Mantel-Haenszel test.

All statistical analyses were conducted using Stata, version 12.0 (StataCorp, College Station, Texas).

RESULTS

During the 5-year study period, 180 jockeys had 505 jockey falls and 269 associated jockey injuries during TB and QH races in California.

Of the 180 jockeys who fell, 71 (39.4%) had 1 reported fall and 109 (60.6%) had more than 1 fall. The mean and median numbers of falls per jockey in TB races were 2.55 (standard deviation [SD], ± 2.05) and 2 (range, 1-10), respectively. In QH races, the mean and median numbers of falls per jockey were 2.74 (SD, ± 2.54) and 2 (range, 1-12), respectively.

In TB races, 141 jockeys experienced 360 falls, with 100 jockeys having 184 substantive injuries that precluded them from riding (substantive injuries occurred in 51.1% of falls) in 180,646 rides in 23,500 races and 3350 race meetings. In QH races, 53 jockeys experienced 145 falls, with 38 jockeys having 85 substantive injuries that precluded them from riding (substantive injuries occurred in 58.6% of falls) in 46,106 rides in 6320 races and 1053 race meetings. Approximately one-third of the reported falls resulted in the jockey being transported to hospital (30.6% in TB races, 31.7% in QH races). Jockey falls occurred, on average, every 502 rides in TB races and every 318 rides in QH races. Jockeys riding in QH races had significantly greater fall (IRR, 1.58; 95% CI, 1.30-1.91; $P < .001$) and injury (IRR, 1.81; 95% CI, 1.40-2.34; $P < .001$) rates than jockeys riding in TB races, but there was no significant difference in the proportion of falls resulting in jockey injury between horse breeds ($P = .126$). The annual jockey fall rates for TB and QH racing did not change ($P = .430$ and $P = .315$, respectively) over the study period (Figure 1).

The proportion of jockey falls that occurred at different times (pre-, during-, post-race) differed by racehorse breed ($P < .001$) (Tables 1 and 2). A similar proportion of pre-race falls occurred in TB and QH racing, but a greater proportion

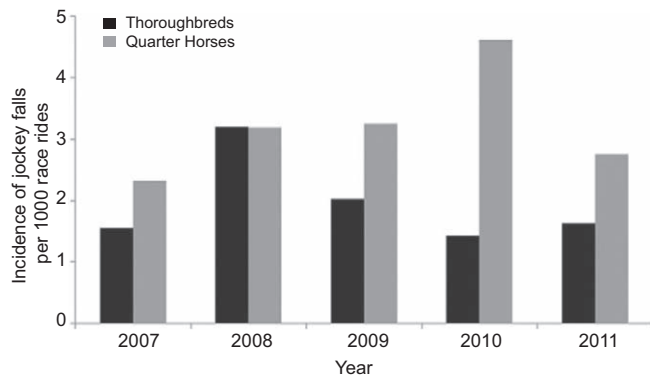


Figure 1. Jockey fall rates from 2007 to 2011 for horse races in California by racehorse breed.

of QH races had jockey falls after the finish line ($P < .001$). In TB races, the majority of falls (81.1%) occurred during the race (23.3% leaving the starting gate, 57.8% during the rest of the race). Only 12.8% occurred before the race (2 [0.6%], 16 [4.4%], and 28 [7.8%] in the paddock, during the post parade, and in the starting gate, respectively) and 6.1% occurred after the finish line (Table 1). In QH races, a smaller majority of falls (57.9%) occurred during the race, a similar proportion (12.4%) occurred before the race (3 [2.1%], 3 [2.1%], and 12 [8.3%] in the paddock, during the post parade, and in the starting gate, respectively), and a larger proportion (29.7%) occurred after the finish line when compared with TB races (Table 2).

Jockeys were more likely to fall as a result of catastrophic injury or death of the horse in QH racing than in TB racing ($P = .001$). When jockeys who fell as a result of being hampered by another horse that experienced a catastrophic injury or death are included, the percentages increased to 46.2% (67/145) and 35.3% (127/360), respectively ($P = .022$). The proportion of jockey falls caused by catastrophic injury or death of the horse differed by time in both TB ($P < .001$) and QH ($P < .001$) races, with a higher proportion occurring during the race than after the race, and none occurring before the race. In TB races, falls related to catastrophic injury or death of the horse were more likely to result in a substantive injury to the jockey (63.5% injured vs 36.5% uninjured) compared with falls that were caused by other reasons (46.1% injured vs 53.9% uninjured) ($P = .003$). This trend was not seen in QH races (60.9% injured and 39.2% uninjured for falls related to catastrophic injury or death of the horse vs 56.8% injured and 43.2% uninjured for falls caused by other reasons; $P = .615$). A large proportion of falls (34.6% [36/104] in TB races; 39.1% [25/64] in QH races) resulted in the jockey being transported to the hospital.

Jockey Death

A total of 152 jockey fatalities occurred as a result of both flat and jump racing or training incidents in the US

($n = 129$; 2 unknown), Canada ($n = 8$), and Mexico ($n = 13$) from 1940 to 2012. Twenty deaths occurred in California. In the current study period, 1 jockey fatality occurred in a QH race, resulting in a mortality rate of 441 per 100 million rides (0.0004%) or 1.99 per 1000 falls (0.20%). In the US during the period 1940 to 2012, occupational jockey deaths occurred at the rate of 1.77 (95% CI, 1.54-2.00) per year (Figure 2). The jockey mortality rate decreased from 2.28 (95% CI, 1.97-2.58) deaths per year before 1980 to 1.15 (95% CI, 0.81-1.49) deaths per year after 1980.

Country Comparison

California had a lower rate of jockey falls for TB racing than those previously reported for other countries in other time periods (Table 3). The incidence of falls per 1000 rides in California was approximately half of the rate reported for Australia (0.48; 95% CI, 0.43-0.53; $P < .001$), Great Britain (0.48; 95% CI, 0.43-0.54; $P < .001$), Ireland (0.53; 95% CI, 0.45-0.63; $P < .001$), and France (0.65; 95% CI, 0.58-0.72; $P < .001$). Both Australia and Japan had data for during-race falls in TB races, and when confining the exposure period to include only falls that occurred during a race, the Californian rate was similar to the rate for Japan but 1.13 times greater (95% CI, 0.99-1.29; $P = .063$) than the rate for Australia.

DISCUSSION

In California, jockey fall rates were lower but injury and fatality rates were comparable to those reported internationally.^{2,6-8,10,11} Rates of jockey falls and injuries were greater for QH races than for TB races. The majority of jockey falls, including falls with a more severe outcome, occurred during a race. A substantial proportion of jockey falls that resulted in an inability to ride in the next scheduled event occurred in concert with a catastrophic injury or sudden death of the horse.

Jockeys riding in QH races had significantly greater fall and injury rates than jockeys riding in TB races. The proportion of jockey falls that resulted in injury was also higher for QH races. The reasons why QH racing jockeys were more likely to fall and be injured are unknown, although QHs race over shorter distances,²³ at greater speeds,¹³ and generally in closer proximity to one another than TBs.

Catastrophic injury or death of the horse was the most common reason for jockey falls in both TB and QH races. In California, the incidence of catastrophic musculoskeletal injury (CMI) in TB races ranges from 1.7 to 2.0 racehorse injuries per 1000 race starts,^{6,23} which is similar to the rates observed in QH races, at 1.7 to 1.8 racehorse injuries per 1000 race starts.^{16,23} Although we would not expect all racehorse injuries or fatalities to result in a jockey fall, as the horse does not always collapse or fall after injury, a disparity was observed in the rates of jockey falls by racehorse breed. There were only 0.58 jockey falls per 1000 race rides in TB races as a result of catastrophic injury or sudden death of the horse compared with 1.39 jockey falls per 1000 race rides in QH races. The higher jockey fall rate

TABLE 1.
Number of Jockey Falls in Thoroughbred Races in California (2007-2011) Stratified by Time and Outcome of Fall

Reason for fall	Pre-Race, n		During-Race, n		Post-Race, n		All Times, n (%)		
	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	Total
Horse injury/death	0	0	61	34	5	4	66 (63)	38 (37)	104 (29)
Broke down			54	30	5	3			
Collapsed			3	2		1			
Suspected bleeder			3	2					
Suspected heart attack			1						
Horse behavior	27	16	3	17	2	0	32 (49)	33 (51)	65 (18)
Bolted	1		2	4	1				
Bucked	1			1					
Broke through gate		2							
Crow hopped				1					
Flipped	5	7							
Fractious	8	2		2					
Jumped shadow			1	3					
Lunged		1							
Propped					1				
Reared	10	3		6					
Wheeled	2	1							
Clipped heels	0	0	27	16	0	0	27 (63)	16 (37)	43 (12)
Hampered by fallen horse/rider	0	0	19	16	0	0	19 (54)	16 (46)	35 (10)
Shifted ground abruptly/ducked in	0	0	20	19	1	3	21 (49)	22 (51)	43 (12)
Stumbled	0	0	8	37	3	1	11 (22)	38 (78)	49 (14)
Other	2	1	5	10	1	2	8 (38)	13 (62)	21 (6)
Bumped			3	4					
Hit running rail			1						
Interference			1	1					
Lost stirrup				1					
Unprepared for start				1					
No reason specified	2	1		3	1	2			
Total by time and outcome, %	29	17	143	149	12	10			
Total by time, n (% of all falls)	46 (13)		292 (81)		22 (6)				
Total by outcome, n (% of all falls)							184 (51)	176 (49)	360 (100)

associated with catastrophic horse injuries observed for QH races could be related to the differences in the types of fatal racehorse injuries that TBs and QHs experience. For example, QHs have a greater proportion of fatal vertebral injuries, which commonly result in sudden collapse of the affected racehorses.^{16,17}

The cause of the jockey fall plays a significant role in the severity of associated injuries. Of the jockey falls that were a direct result of catastrophic injury or death of the horse, approximately 60% resulted in an injury to the jockey that precluded him or her from being able to ride in the next race. Additionally, some jockeys experienced a fall or injury when the horse they were riding could not avoid a fallen horse. When a horse experiences a catastrophic injury or sudden death and collapses while traveling at speeds around 35 mph, the jockey falls with the horse and is more likely to suffer a serious injury and pose additional risk to adjacent horses and their jockeys. An Australian study⁹ of video footage of falls by jockeys during races reported 3 primary injury-producing fall modes: a forward dive into the track as the horse stumbled, a fall from the side of the horse while holding onto the reins, and a fall following being pitched into the air or thrown from the horse. These falls translated to impact velocities ranging from 20

to 30 mph (30-50 kph) and heights of up to 11 feet (3.5 m). Additionally, there was a risk of the rider being trampled or crushed by a fallen horse after hitting the track.⁹

Two other studies have reported on the cause of jockey falls but comparisons could not be made because of differences in reporting. A study in Japan (1997-2000) found that the majority of jockey falls occurring during a flat race were caused by the horse stumbling (25.5%), followed by the horse being injured (20.1%), error by the jockey (19.1%), involvement in an accident (12.2%), bad behavior of the horse (11.2%), interference (11.2%), and other unspecified causes (0.7%).¹⁴ In an Australian study (2002-2006),¹¹ it was reported that during the race, only 4.9% of falls were due to horse catastrophic injury and 2.2% were attributed to being hampered by a fallen horse or rider. However, in that study, no underlying reason was specified for almost half of all falls. In agreement with the current study, the Australian study¹¹ attributed nearly all pre-race falls to the fractious behavior of the horse.

Jockeys in California more commonly experienced race-day-related falls during a race. The low proportion of falls that occurred pre-race in California is in stark contrast to that observed by an Australian study,¹¹ where 54.6% of falls and 26.8% of injuries occurred prior to the start of the

TABLE 2.
Number of Jockey Falls in Quarter Horse Races in California (2007-2011) Stratified by Time and Outcome of Fall

Reason for fall	Pre-Race, n		During-Race, n		Post-Race, n		All Times, n (%)		Total
	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	Injured	Uninjured	
Horse injury/death	0	0	22	11	17	14	39 (61)	25 (39)	64 (44)
Broke down			21	10	17	13			
Collapsed			1	1		1			
Suspected bleeder									
Suspected heart attack									
Horse behavior	12	3	6	5	2	0	20 (71)	8 (29)	28 (19)
Bolted			2	1	2				
Bucked	1		4	2					
Broke through gate									
Crow hopped									
Flipped	6	2							
Fractious	3	1		1					
Jumped shadow									
Lunged				1					
Propped									
Reared	2								
Wheeled									
Clipped Heels	0	0	3	4	2	1	5 (50)	5 (50)	10 (7)
Hampered by fallen horse/rider	0	0	0	0	1	2	1 (33)	2 (67)	3 (2)
Shifted ground abruptly/ducked in	0	0	6	6	0	0	6 (50)	6 (50)	12 (8)
Stumbled	1	0	2	10	3	0	6 (38)	10 (63)	16 (11)
Other	2	0	5	4	1	0	8 (67)	4 (33)	12 (8)
Bumped			2		1				
Equipment failure			2						
Hit running rail									
Interference				3					
Locked up			1						
Lost stirrup				1					
Unprepared for start									
No reason specified	2								
Total by time and outcome, %	15	3	44	40	26	17			
Total by time, n (% of all falls)	18 (12)		84 (58)		43 (30)				
Total by outcome, n (% of all falls)							85 (59)	60 (41)	145 (100)

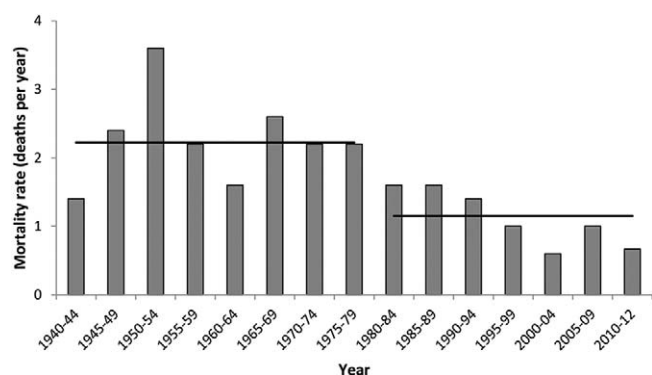


Figure 2. Mean jockey mortality rate in the United States, 1940-2012.

race. This difference may be explained by the extensive use of lead ponies in the US. A lead pony and its rider accompany the racehorse during the post parade to the starting gate to help the jockey keep the racehorse under control.

The current study is in closer agreement with another US study on injuries compiled by an insurance broker.²⁴ The insurance broker study reported that 20.9% of jockey injury events occurred pre-race compared with the values of 15.7% in TB races and 17.6% in QH races reported in the current study. Similarly, we found that 6.1% of injuries occurred after the finish line in TB races compared to 7.0% that occurred at the finish line in the study of insurance data.²⁴ In contrast, in QH races, post-race jockey falls accounted for approximately one-third of all QH race falls and injuries. The time of jockey fall may be related to race distance.

In TB races, the incidence of jockey falls was lower in California than in Australia,^{7,11} the United Kingdom, Ireland, and France,^{8,12,22} but the injury and fatality rates were not different compared to these countries. This lower rate of falls is explained by the lower proportion of pre-race falls, which may be attributed to the use of lead ponies prior to the start of the race, as mentioned previously. However, more than half of all falls resulted in an injury, a proportion which was higher than that in other countries (27%-44%—not including Japan, where only during-race falls were reported). The fall rate for during-race falls, however, was

TABLE 3.
Incidence Rates for Jockey Falls, Injuries, and Fatalities^a

	California				
	Quarter Horses	Thoroughbreds	Australia ¹¹	Japan ¹⁴	Europe ^{8,12,22}
Study period	2007-2011	2007-2011	2002-2006	1998-2000	1991-2006
Information source	Stewards' reports	Stewards' reports	Stewards' reports	Unknown	Medical officer
Falls per 1000 rides, n	3.14	1.99	4.17	—	2.68-4.44
Falls per 1000 rides (during race), n	1.82	1.62	1.43	1.62	—
Injuries per 1000 rides, n	1.84	1.02	1.12	—	1.19-1.76
Injury incidence per fall, %	59	51	27	~50	34-44
Fatalities, ^b n	441	0	673	—	338-419 ^c

^aInternational rates are for Thoroughbred races only. Fall and injury incidence rates can be interpreted as a percentage of rides or per 1000 rides.

^bFatality incidence rates are per 100 million rides.

^cFrance fatality incidence rates were recorded from 1980-2001, United Kingdom rates were recorded from 1975-2000.

comparable to Japan¹⁴ but higher than Australia.¹¹ During-race falls are generally more severe, with approximately half resulting in an injury to the jockey.^{11,14} Furthermore, jockey falls that occurred during races comprised 77.7% of the total jockey injuries sustained in TB races, compared with 61.7% for TB racing in Australia¹¹ and 70% in Great Britain and Ireland.²²

The rate of jockey injuries in the US appears to have decreased over time. A study conducted 3 decades earlier in Seattle reported a jockey injury incidence of 24 jockey injuries per 1000 races.²⁵ This rate is higher than that reported in the current decade, with 8 (184 of 23,500) jockey injuries per 1000 races in TB races and 13 (85 of 6320) jockey injuries per 1000 races in QH races. Whitesel²⁵ defined an injury as an event requiring medical attention by the track physician, which resulted in the rider being unable to compete in 1 or more races. Thus, the reduction in the jockey injury rate over time is likely due to improved safety standards, as also evidenced by the reduction in the number of jockey fatalities, rather than due to a notable difference in reporting.

This study is the first from the US to present descriptive characteristics of jockey falls and incidence rates of jockey falls, injuries, and fatalities that could be compared with those reported by other countries^{8,11,12,14,22} and is the first to report on jockey falls in QH races. However, these data only represent jockey falls and injuries incurred in California, a state that makes up approximately 9% of racing in the US.¹⁹ Information was not available for jockey falls and injuries that occurred during training.

Lastly, the jockey accident reports and stewards minutes provided a comprehensive record of incidents observed by stewards at a race meeting but were not designed for medical diagnosis of injuries sustained. The data likely underestimate injuries due to the exclusion of injuries that did not preclude the jockey from riding a horse in the next scheduled race. In 2011, the British Horseracing Authority facilitated a meeting to standardize the reporting of jockey injuries for use in epidemiological studies²¹; but a standardized jockey injury reporting system for the US racing industry is not currently in place, and this deficiency has previously been identified by the US Department of Health

and Human Services.¹⁰ Notwithstanding, the Jockey's Guild has announced the creation of a jockey injury database that is currently being piloted in Keeneland, Kentucky.¹⁸ The implementation of this database nationwide will be a big step forward for improving jockey safety standards for the US racing industry.

CONCLUSION

In California, the rate of jockey falls in QH racing is significantly higher than that of TB racing. The high proportion of jockey falls as a result of horse injury or fatality is a cause for concern. Prevention strategies aimed at improving horse injury and fatality rates will in turn lead to a reduction in jockey falls and injuries.

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