

Evaluation of catastrophic musculoskeletal injuries in Thoroughbreds and Quarter Horses at three Midwestern racetracks

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Objective—To determine the incidence of and compare the types of catastrophic musculoskeletal injuries (CMIs) sustained in Thoroughbreds and Quarter Horses during racing at 3 Midwestern racetracks from 2000 to 2006.

Design—Retrospective cohort study.

Animals—139 Thoroughbred and 50 Quarter Horse racehorses euthanized because of CMIs.

Procedures—Veterinary officials from 3 Midwestern racing jurisdictions provided injury reports for Thoroughbreds and Quarter Horses that sustained CMIs (which required euthanasia) and the total number of race starts for each year. The number of CMIs/1,000 starts was determined for each racetrack. Past performance reports for each horse with a CMI were evaluated.

Results—The total number of race starts (both breeds) at the 3 racetracks from 2000 through 2006 was 129,460, with an overall incidence of 1.46 CMIs/1,000 race starts. Incidences of CMIs among racetracks were similar. Of horses that sustained a CMI, the median age of Thoroughbreds at first race was 3 years, compared with a median age of 2 years for Quarter Horses. A larger proportion of Thoroughbreds sustained a CMI in a claiming race than did Quarter Horses, and a larger proportion of Quarter Horses sustained a CMI in a futurity trial than did Thoroughbreds. The most common site for CMIs in Thoroughbreds was the left forelimb (69/124 [55.6%]), whereas most CMIs in Quarter Horses involved the right forelimb (18/30 [60.0%]).

Conclusions and Clinical Relevance—Differences identified between CMIs in Thoroughbred and Quarter Horse racehorses should allow veterinarians to focus on horses and anatomic regions of greatest risk of CMI during racing. (*J Am Vet Med Assoc* 2011;239:1236–1241)

Injuries sustained by equine athletes in the Thoroughbred and Quarter Horse racing industries are a concern to those within the business and to the public viewers of the sport. Catastrophic injuries to racehorses have encouraged jurisdictions to determine their CMI incidence and have stimulated investigation in an attempt to identify the factors that may contribute or predispose these horses to severe injuries.^{1–9} A number of racing jurisdictions have been thoroughly studied^{3,4,10–12}; however, there is little information published from the smaller racing jurisdictions in the Midwest.^{13,14} Midwestern racing jurisdictions catering to smaller breeding and training operations are important to consider in gauging the health and safety of racehorses across the country.

Midwestern horseracing venues are jurisdictions that often have smaller racing stables and where the horses are of lesser financial value. To date, there has

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ABBREVIATION

CMI Catastrophic musculoskeletal injury

been minimal information available about CMIs in these smaller racing jurisdictions. The CMI incidence of this population may be different than those previously reported.

The purposes of the study reported here were to describe the incidence of CMIs for both Thoroughbred and Quarter Horse racehorses at 3 Midwestern racetracks and to determine whether there are differences in the incidence of CMIs among these 3 facilities. Additional purposes of this study were to evaluate a number of factors that may affect the occurrence of CMIs, describe the horse populations, compare Thoroughbred and Quarter Horse racehorses that sustained a CMI, and determine whether there are differences between these populations for the factors evaluated. Each of the 3 racetracks included in this study conducted both Quarter Horse and Thoroughbred race meets either jointly or at separate times during the year. There is little information available concerning CMIs in Quarter Horse racing,^{15,16} and the facilities evaluated in this study provided an opportunity to compare Thoroughbred and Quarter Horse racing injuries.

Materials and Methods

Three Midwestern racetrack facilities (ie, Prairie Meadows Racetrack in Altoona, Iowa; The Woodlands Racetrack in Kansas City, Kan; and Remington Park Racetrack in Oklahoma City, Okla) were chosen for this study on the basis of their interest in participating and willingness to provide complete injury records. Records from 2000 through 2006 for Prairie Meadows Racetrack and Remington Park Racetrack and from 2002 through 2006 for The Woodlands Racetrack were obtained. For both Thoroughbreds and Quarter Horses, information on total race starts and CMIs and additional information for each horse with a CMI and each race during which a CMI occurred were documented. For this study, a CMI was defined as an injury necessitating euthanasia by the attending racetrack veterinarian either during or immediately following a race. Catastrophic musculoskeletal injuries that occurred during training hours were not included. Horses not euthanized were considered to have noncatastrophic injuries and were not included. Catastrophic musculoskeletal injuries included those involving bones, tendons, and ligaments. Racing fatalities due to pulmonary hemorrhage or cardiac problems were not included in this study. Horses must have started the race (left the race gate) before incurring the injury to be included in the study. A past performance history was acquired for each horse with a CMI from a national Thoroughbred and Quarter Horse racing reporting system.^a In addition, each racetrack or their referring veterinary institution supplied available documentation on pathologic findings detailing the type of musculoskeletal injury sustained and the total number of Thoroughbred and Quarter Horse starters for the race meets included in the study.

The following variables were recorded for each horse entered in the study: study identification number, horse information (name, owner, trainer, and jockey), date of injury, breed (Thoroughbred or Quarter Horse), racetrack (Prairie Meadows Racetrack, The Woodlands Racetrack, or Remington Park Racetrack), sex (sexually intact male, gelding, or female), age when the CMI occurred (years), racetrack surface (dirt or turf), racetrack condition (dirt: fast, good, sloppy, or muddy; turf: firm or good), race distance (yards for Quarter Horses and furlongs for Thoroughbreds), number of horses in field, type of race (maiden or maiden special weight, maiden claiming, allowance, claiming, derby or futurity trial, and stakes race or handicap), purse (dollars), weight carried (pounds), post position in the race where injury occurred, lifetime earnings (dollars), total lifetime race starts, age at first race start (years), limb injured, type of injury (fracture or soft tissue), anatomic structure injured, and prerace medication (phenylbutazone, furosemide, or both).

Statistical analysis—All data were entered into a spreadsheet^b and imported into a statistical software package^c for analysis. The overall CMI incidence per racetrack, year, and breed were calculated by dividing the number of CMIs of each group by the total race starts for the group and multiplying by 1,000. Then, the binomial response of the number of CMIs/1,000 race starts was analyzed by use of logistic regression, with

racetrack, year, and breed as explanatory variables. Multiple linear regression was used to analyze the relationship between the number of CMIs and the explanatory variables including racetrack, year, breed, and the number of race starts. An ANOVA model was used to analyze the number of race starts, with racetrack, breed, and their interaction as explanatory variables.

To identify differences for categorical variables between Thoroughbred and Quarter Horse racehorses with CMIs, the Fisher exact test was used. For comparison of quantitative variables, equality of the variance was determined. For those with similar variance between groups, 2 sample *t* tests were applied and the Satterthwaite *t* test with unequal variance was reported for those with unequal variance. Values of $P \leq 0.05$ were considered significant.

Results

CMI incidence—The total number of race starts at the 3 racetracks from 2000 through 2006 was 129,460 for Thoroughbreds and Quarter Horses combined, with an overall incidence of 1.46 CMIs/1,000 race starts. There were a total of 139 CMIs in Thoroughbreds for a CMI incidence of 1.48 and 50 CMIs in Quarter Horses for a CMI incidence of 1.36.

There were 54,279 race starts at Prairie Meadows Racetrack from 2000 through 2006 with 70 total CMIs, yielding an incidence of 1.29 CMIs/1,000 race starts. The total number of Thoroughbred race starts at Prairie Meadows Racetrack during the study period was 42,615 with 56 CMIs, yielding an incidence of 1.31 CMIs/1,000 race starts. At the same racetrack, there were 11,664 Quarter Horse race starts with 14 CMIs, yielding an incidence of 1.20 CMIs/1,000 race starts.

There were 12,212 race starts at The Woodlands Racetrack from 2002 through 2006 with 20 total CMIs, yielding an incidence of 1.64 CMIs/1,000 race starts. The total number of Thoroughbred race starts at Prairie Meadows Racetrack during the study period was 8,645 with 15 CMIs, yielding an incidence of 1.74 CMIs/1,000 race starts. At the same racetrack, there were 3,567 Quarter Horse race starts with 5 CMIs, yielding an incidence of 1.40 CMIs/1,000 race starts.

There were 62,949 race starts at Remington Park Racetrack from 2000 through 2006 with 99 total CMIs, yielding an incidence of 1.57 CMIs/1,000 race starts. The total number of Thoroughbred race starts at Prairie Meadows Racetrack during the study period was 41,433 with 68 CMIs, yielding an incidence of 1.64 CMIs/1,000 race starts. At the same racetrack, there were 21,516 Quarter Horse race starts with 31 CMIs, yielding an incidence of 1.44 CMIs/1,000 race starts.

When the number of CMIs/1,000 race starts were analyzed, there was no significant effect of year ($P = 0.908$), racetrack ($P = 0.407$), or breed ($P = 0.420$) on CMI incidence. The only significant ($P < 0.001$) effect on the number of CMIs at a racetrack was the number of race starts at a racetrack. There was a significant ($P < 0.001$) difference in the number of race starts among racetracks, a significant difference ($P < 0.001$) between the number of Thoroughbred race starts versus Quarter Horse race starts, and a significant ($P < 0.001$) interaction between the breed (Thoroughbred and Quarter

Horse) and racetrack. At The Woodlands Racetrack, there were fewer race starts than at Prairie Meadows Racetrack ($P < 0.001$) and Remington Park Racetrack ($P < 0.001$) and overall fewer Quarter Horse race starts than Thoroughbred race starts ($P < 0.001$).

Characteristics of injured horses—Complete information was available for 124 of 139 Thoroughbreds and 30 of the 50 Quarter Horses that had a CMI. Thoroughbreds had equal numbers of geldings (49/124 [39.5%]) and females (49/124 [39.5%]) and fewer sexually intact males (26/124 [21.0%]) that sustained a CMI. The distribution of Thoroughbreds was not significantly ($P = 0.248$) different from that of Quarter Horses, for which the highest number of CMIs occurred in geldings (17/30 [56.7%]), compared with females (9/30 [30%]) and sexually intact males (4/30 [13.3%]). Thoroughbreds were older (median, 4 years; range, 2 to 9 years) than Quarter Horses (median, 3 years; range, 2 to 7) at the time of CMI, but this difference was not significant ($P = 0.056$). Only 6.5% (8/124) of CMIs in Thoroughbreds occurred when they were 2 years old, with most occurring at 3 years of age (51/124 [41.1%]) and fewer at 4 years of age (33/124 [26.6%]). Two-year-old Quarter Horses sustained 30% (9/30) of the CMIs among this breed, with 26.7% (8/30) of CMIs occurring at 3 years of age and 23.3% (7/30) of CMIs occurring at 4 years of age. There were 10 CMIs in Thoroughbreds that occurred on a firm turf course, which constituted all of the data included in this study for turf events. Among the CMIs that occurred on a fast-racing dirt racetrack surface, 89.4% (102/114) occurred in Thoroughbreds and 83.3% (25/30) occurred in Quarter Horses ($P = 0.434$).

As expected, there was a significant ($P < 0.001$) difference in race distance between Thoroughbreds and Quarter Horses. The races in which Thoroughbreds sustained a CMI were longer (median, 6 furlongs [1,320 yards]; range, 5 to 10 furlongs [1,100 to 2,200 yards]), compared with those of the Quarter Horses (median, 350 yards; range, 100 to 870 yards). Most Thoroughbreds that sustained CMIs were in 6-furlong races (46/124 [37.1%]), compared with Quarter Horses, in which CMIs were greatest at 350 yards (14/30 [46.7%]). The field sizes were similar ($P = 0.2169$) for Thoroughbreds (median, 9 horses; range, 5 to 13 horses) and Quarter Horses (median, 9 horses; range, 6 to 11 horses).

Most CMIs in Thoroughbreds occurred in claiming races (68/124 [54.8%]). For Quarter Horses, both the stakes-handicap (12/30 [40.0%]) and maiden-maiden special weight (7/30 [23.3%]) racing categories were most common in terms of CMIs. The distribution of race type was significantly ($P < 0.001$) different between Thoroughbreds and Quarter Horses with CMIs. Data were also evaluated as maiden races versus all other types, claiming races versus all other types, and futurity trials versus all other types. There was not a significant ($P = 0.175$) difference in the incidence of CMIs between Thoroughbreds and Quarter Horses for maiden races; however, there was a significantly ($P < 0.001$) larger proportion of CMIs in Thoroughbred claiming races than in Quarter Horse claiming races and a significantly ($P < 0.001$) larger proportion of Quarter Horses than Thoroughbreds with CMIs sustained in futurity trials.

The purse value of the race in which the CMI occurred for Thoroughbreds (median \$9,000; range, \$1,680 to \$75,000) was not significantly ($P = 0.999$) different than that for the Quarter Horses (median \$7,500; range, \$1,600 to \$65,000). The weight carried by Thoroughbreds (median, 53.6 kg [118 lb]; range, 49.5 to 56.4 kg [109 to 124 lb]) was significantly ($P < 0.001$) different from the weight carried by Quarter Horses (median, 55.5 kg [122 lb]; range, 54.5 to 57.7 kg [120 to 127]).

Median Thoroughbred lifetime earnings was \$13,886 (range, \$0 to \$359,977), and the Quarter Horse median earnings was \$6,251.50 (range, \$42 to \$267,989), which were not significantly ($P = 0.397$) different. There was a significant ($P = 0.049$) difference in the number of lifetime race starts between Thoroughbreds (median, 11 race starts; range, 1 to 110 race starts) and Quarter Horses (median, 7.5 race starts; range, 1 to 51 race starts). The median age at first race start for Thoroughbreds that sustained CMIs was 3 years (age range, 2 to 5 years), whereas the median age for first race start for Quarter Horses that sustained CMIs was 2 years (age range, 2 to 5 years; $P = 0.001$).

Most CMIs in Thoroughbreds occurred in the left forelimb (69/124 [55.6%]), whereas most CMIs in Quarter Horses involved the right forelimb (18/30 [60.0%]). There was a significant ($P = 0.029$) difference between Thoroughbreds and Quarter Horses in terms of the limb in which the injury most commonly occurred. The left forelimb was significantly ($P = 0.008$) more likely to be involved than any other limb in Thoroughbreds (right forelimb, 37/124 [29.8%]; both forelimbs, 12/124 [9.7%]; right hind limb, 4/124 [3.2%], left hind limb 1/124 [0.8%]; and both hind limbs, 1/124 [0.8%]), and the right forelimb was significantly ($P = 0.003$) more likely to be involved than any other limb in Quarter Horses (left forelimb, 8/30 [26.7%]; both forelimbs, 3/30 [10%]; right hind limb, 1/30 [3.3%], and left hind limb, 0). Neither breed was significantly ($P = 1.0$) more likely to have multiple limbs involved.

Fractures accounted for most CMIs in both breeds, occurring in 92.7% (115/124) of Thoroughbreds and 90% (27/30) of Quarter Horses, which was not significantly ($P = 0.703$) different. Injuries were recorded in 10 categories, and there were no significant ($P = 0.072$) differences between breeds in the type of CMI sustained. The most frequent injury for both breeds was proximal sesamoid bone fractures occurring in 38.7% (48/124) of Thoroughbreds and 30% (9/30) of Quarter Horses. This was followed by carpal bone fractures in 21.8% (27/124) of Thoroughbreds and 23.3% (7/30) of Quarter Horses. Third metacarpal bone fractures occurred in 20.2% (25/124) of Thoroughbreds and 10% (3/30) of Quarter Horses. Metacarpophalangeal joint disruption with proximal sesamoid bone and third metacarpal bone fracture occurred in 8.1% (10/124) of Thoroughbreds and 6.7% (2/30) of Quarter Horses. When injuries of the metacarpophalangeal joint were grouped together (proximal sesamoid bone, suspensory ligament, and a combination of proximal sesamoid bone and third metacarpal bone fracture), they accounted for 48.4% (60/124) of the injuries in Thoroughbreds and 40% (12/30) of the injuries in Quarter Horses ($P = 0.4242$). There were only 2 Thoroughbreds (2/124 [1.6%]) with humeral fractures, com-

pared with 4 Quarter Horses (4/30 [13.3%]) with humeral fractures. When humeral fractures were compared between breeds versus all other injuries, Quarter Horses were overrepresented ($P = 0.014$). Most Thoroughbreds (105/124 [84.7%]) and Quarter Horses (22/30 [73.3%]) raced after premedication with both furosemide and phenylbutazone ($P = 0.178$).

Discussion

In the present study, the combined CMI incidence for Thoroughbreds of 1.48 CMIs/1,000 race starts is consistent with overall CMI values reported for other Thoroughbred racing jurisdictions including Florida,³ Kentucky,⁴ California,⁵ New York,¹¹ and Ontario, Canada.¹² The incidence of CMIs in Quarter Horses in the present study was 1.36 CMIs/1,000 race starts. The only comparable data are those from the study by Cohen et al.¹⁵ who reported 0.8 catastrophic injuries and 2.2 musculoskeletal injuries/1,000 race starts. In that study,¹⁵ a regulatory official determined whether it was likely that the horse could be saved, while the present study included all horses that were euthanized, which may have included some horses that were euthanized on the basis of economic consideration. To the authors' knowledge, the present study is the first to evaluate Quarter Horse racehorses at the same facilities as Thoroughbred racehorses. Our data indicate that the incidence of CMIs for both Thoroughbred and Quarter Horse racehorses is not significantly different.

Our interpretation of a CMI needs to include understanding study details. In the present study, we included only CMIs associated with an actual race from which the horse successfully left from the race gate to begin racing and did not include cardiovascular events. Other studies have incorporated training injuries,¹² have separated horses that are injured in the race gate,¹⁵ or may have used a definition or timeframe of a CMI different than that used in the present study. This study excluded nonmusculoskeletal issues such as cardiovascular failure and exercise-induced pulmonary hemorrhage, similar to other studies.^{4,7,15}

The retrospective data to describe CMIs in the present study were used to compare data between Thoroughbreds and Quarter Horses at these racetracks. There was no effort to evaluate the data on the basis of how the types of races to run were determined (ie, written) for each racetrack. Clearly, a number of differences including distance and weight carried would be expected between breeds on the basis of how races are written for the 2 breeds. Some potential differences could be related to more claiming races being provided for Thoroughbreds. Additionally, there were a higher number of futurity trials and futurities for the Quarter Horses, which did not occur in Thoroughbred racing. The present study did not evaluate risk factors on the basis matched controls; comparisons were limited to differences between Thoroughbred and Quarter Horse racehorses. Another limitation of this study was that data beyond the recording of a CMI in all Quarter Horse races were not available for 20 Quarter Horses early in the period studied.

The present study did not identify a difference in sex distribution of CMI incidence between breeds.

Three previous studies^{3,6,12} indicated that sexually intact male Thoroughbreds were more likely to sustain a CMI; however, sex was not found to influence the risk of CMI in a previous Quarter Horse study.¹⁵ There was a difference in age for when CMIs occurred between Thoroughbred and Quarter Horse racehorses, but this difference was not significant ($P = 0.056$). The highest percentage of CMIs occurred in 3-year-old Thoroughbreds and 2-year-old Quarter Horses. When evaluating the risk factor data published to date, it has been reported that the older the horse, the higher risk of a CMI. This may be related to more exposure to racing.^{5,17} It has also been reported that 4-year-old Thoroughbreds are at twice the risk of having a CMI, compared with 3 year olds.⁵ A descriptive study¹⁶ of racing Quarter Horses in California included 39% of 3 year olds and 32% of 2 year olds that developed CMIs. A Texas study¹⁵ reported more 2-year-old than 3-year-old Quarter Horses with CMIs, but the difference was not significant. In the present study, there was an even distribution of 2-, 3-, and 4-year-old Quarter Horses. The total number of horses of each breed and age racing on these racetracks is unknown. It is possible that more 2-year-old Quarter Horses were racing and that the incidence per group would increase with age. This would be comparable with the reported incidence of increased risk of more race starts with age.

In the present study, the median race length for Thoroughbreds that sustained CMIs was at a distance of 6 furlongs (46/124 [37.1%]). This finding is similar to that reported in New York,¹¹ which revealed the highest incidence of CMIs occurred for Thoroughbreds in races with a distance of 6 furlongs. Distance has been reported as being a significant risk factor for injury in Thoroughbreds,⁴ with a greater risk in shorter races that would appear similar to the horses in the present study. Horses racing shorter distances would likely be racing at a higher speed, which places more force on the forelimbs.¹⁸ However, data on race speed were not included in the present study. In the present study, 46.7% (14/30) of CMIs in Quarter Horses were in races of 350 yards.

There were significant ($P < 0.001$) differences between Thoroughbreds and Quarter Horses in the types of races where CMIs occurred. In the present study, there was a predominance of CMIs among 2-year-old Quarter Horses running in nonclaiming races, compared with Thoroughbreds over age 3 years competing in claiming races. This could have been due to differences in races being run at these racetracks. Younger Quarter Horses may be more commonly raced in 2-year-old futurities, and there may be more races available for older Thoroughbreds with a predominance of claiming races.

Most (68/124 [54.8%]) CMIs in Thoroughbreds occurred in claiming races. It has been documented that Thoroughbreds in claiming races are at a relatively high risk of developing CMIs.^{6,14} This is likely the result of lower quality or injured racehorses with a higher risk for developing a fracture being placed in these races.¹⁹ In contrast to Thoroughbreds, the predominance of CMIs among Quarter Horses (12/30 [40.0%]) occurred in stakes-handicap racing categories. Our data are similar to those reported for Quarter Horse racing in Texas, where significantly fewer injuries occurred in claiming

races than in nonclaiming races,¹⁵ and different from California where most (60%) of the CMIs in Quarter Horses occurred in claiming races.¹⁶ This difference may be attributed to the quality of horses and the types of races provided for these jurisdictions.

The median lifetime earnings for the Thoroughbred and Quarter Horse racehorses sustaining CMIs were relatively low (\$13,886 and \$6,251, respectively). Reasons for low lifetime earnings may differ between breeds. Thoroughbreds had significantly more race starts, were older, and were running in relatively short claiming races. This may indicate that Thoroughbreds sustaining CMIs were less-talented horses. The Quarter Horses in the present study were predominantly 2 year olds (9/30 [30%]). Many of these injuries occurred in futurity trials and futurities. This could indicate that Quarter Horses are being pushed hard as yearlings and 2 year olds to reach the higher paying 2-year-old futurity races.

It has been shown in a number of studies^{4,5,8,12,15,19} that forelimbs are most commonly injured in racehorses. Some studies^{4,5} have shown the left forelimb is more commonly affected, and others have shown no limb predilection.^{8,12,15} The predilection for forelimbs is expected in relation to how horses load the forelimbs. In the present study, there was a significant ($P = 0.029$) difference between the left forelimb involvement in Thoroughbreds and the right forelimb involvement in Quarter Horses. A potential explanation may be that the injury is associated with the lead limb when the injury occurs. Additionally, as Quarter Horses are slowed at the end of the race, a horse in the right lead are entering a left-hand turn that could affect limb loading and balance, which could also contribute to CMIs of the right forelimb.

Peak vertical force is greatest in the lead forelimb followed by the nonlead forelimb.¹⁸ In video analysis, 66% of horses with a forelimb fracture fractured the limb they were using as the lead forelimb at the time of fracture,²⁰ and most limbs injured were lead forelimbs, irrespective of direction of racing.¹⁹ Thoroughbreds in the United States race counterclockwise and are typically on the left lead in the turns. Quarter Horses running sprint races will typically take a single lead from the gate to the finish. If more Quarter Horses break from the gates on the right lead rather than the left lead, this could account for the difference in forelimb injuries between Thoroughbreds and Quarter Horses.

Some previous studies^{5,6,10} have had predetermined categories for injuries and multiple injuries in the same horse and were ranked on the basis of relevance by a single pathologist. In the present study, predetermined definitions of injury sites were not available and numerous veterinarians were responsible for postmortem examination. It is possible that some horses in the present study had multiple anatomic structures involved, but only 1 primary area of injury was recorded on the necropsy report. However, data compiled in the present study are similar to that of other studies. The most frequent injury for both breeds was proximal sesamoid bone fractures (48/124 [38.7%] for Thoroughbreds and 9/30 [30%] for Quarter Horses), followed by carpal bone fractures (27/124 [21.8%] for Thoroughbreds and

7/30 [23.3%] for Quarter Horses). When the injuries of the suspensory apparatus at the metacarpophalangeal joint were grouped together, they accounted for 48.4% (60/124) of injuries in Thoroughbreds and 40% (12/30) of injuries in Quarter Horses. All of these findings are consistent with those of previous studies^{4,7,8,15,21} in both Thoroughbred and Quarter Horse racehorses. The high occurrence of humeral fractures (4/30 [13.3%]) in Quarter Horses was significantly ($P = 0.014$) overrepresented, compared with the occurrence in Thoroughbreds, and higher than those reported by others.^{15,21} The reason for this is unknown. No vertebral body fractures in Quarter Horses, which accounted for 9% to 10% of CMIs in previous studies,^{15,21} were identified in the present study.

This study provided updated information regarding CMI incidences at Midwestern horse racing facilities and shows these incidence rates are similar to those of larger racing jurisdictions. Undoubtedly, there are complex interactions and risk factors associated with the development of CMIs in racehorses, which may be different among venues. This study reveals that there are a number of differences to consider when evaluating CMIs in Thoroughbred and Quarter Horse racehorses. Future studies need to investigate these differences and continue to identify risk factors associated with CMIs of the racing equine athlete.

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 - b. Excel, Microsoft Office, Microsoft Redmond, Wash.
 - c. SAS software, version 9.1.3. Service Pack 4, SAS System for Windows, SAS Institute Inc, Cary, NC.
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From this month's *AJVR*

Serologic response to *Mannheimia haemolytica* in calves concurrently inoculated with inactivated or modified-live preparations of *M haemolytica* and viral combination vaccines containing modified-live bovine herpesvirus type 1

Victor S. Cortese et al

Objective—To assess the serologic response of calves to inactivated and modified-live (ML) *Mannheimia haemolytica* (MH) preparations given alone and concurrently with combination viral vaccines containing ML bovine herpesvirus type 1 (BHV-1).

Animals—642 calves seronegative for BHV-1.

Procedures—In experiment 1, 192 calves received 1 of 3 MH preparations alone or concurrently received 1 of 3 MH preparations and 1 of 4 combination viral vaccines. In experiment 2, 450 calves received 1 of 4 MH preparations alone or concurrently received 1 of 4 MH preparations and 1 of 5 combination viral vaccines. Pretreatment and posttreatment blood samples were processed to obtain serum, which was analyzed to detect concentrations of antibodies against MH leukotoxin and BHV-1.

Results—In experiment 1, antibody titers against MH leukotoxin in calves receiving MH and ML virus vaccine appeared decreased, albeit nonsignificantly, compared with titers for calves receiving MH preparations alone. In experiment 2, all groups (except for 1) concurrently receiving an MH preparation and viral vaccine had a significant decrease in antibodies against MH leukotoxin. In both experiments, there was a significant decrease in the number of calves responding to MH leukotoxin when ML viral vaccine was coadministered.

Conclusions and Clinical Relevance—Coadministration of ML BHV-1 and MH preparations interfered with the serologic response to MH leukotoxin in calves seronegative for BHV-1. Serologic response to MH leukotoxin may be substantially improved in seronegative calves when MH vaccination is delayed until after calves have received a dose of ML BHV-1 vaccine. (*Am J Vet Res* 2011;72:1541–1549)



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