Thoroughbred Racehorses that Sustain Injury Accumulate Less High Speed Exercise Compared to Horses Without Injury in Kentucky

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In Kentucky, injured horses accumulated significantly less high-speed exercise relative to control horses during the 1- and 2-month periods prior to the race in which injury occurred. Because these findings differ from those observed in California, the association of injury with accumulation of high-speed exercise appears variable among regions in the United States. Authors’ addresses: Department of Large Animal Medicine & Surgery, College of Veterinary Medicine, Texas A&M University, College Station, TX 77843-4475 (Cohen, Peloso); Department of Statistics, College of Science, Texas A&M University, College Station, TX, 77843-3143 (Berry); the Kentucky Racing Commission, 4063 Iron Works Pike, Lexington, KY 40502 (Mundy); Wayward Farm, 10320 Pine Valley Drive, Woodbridge, Ontario, Canada L4L 1A6 (Howard). © 2000 AAEP.

Introduction
The reported frequencies of catastrophic racing injury have been similar among regions of the United States.1 Evidence exists, however, that risk of injury and risk factors for injury may vary by geographical region. For example, sex was an important risk factor for injury in California but not in Kentucky.2,3 The incidence of soft tissue injuries incurred during racing varied among racetracks in various regions of the United States.4 These findings underscore the importance of examining the possibility of regional differences in the role of putative risk factors for racing injury among Thoroughbreds. The purpose of this study was to investigate the association of racing injury with high-speed exercise, as has been reported by investigators in California.5

Materials and Methods
Horses
Thoroughbreds racing at four racetracks in Kentucky (Churchill Downs, Ellis Park, Keeneland Raceway, and Turfway Park) between March 1, 1994 and February 28, 1996 were included. All horses that sustained a musculoskeletal injury during racing during this period were eligible for inclusion. Injuries were categorized as catastrophic or noncatastrophic. For each injured horse, 2 horses from the same race that were not injured were selected at random as controls; all controls were eligi-
Table 1. Odds ratios* for the Association of Racing Injury with High-speed Exercise Variables and Beyer’s Numbers Among Thoroughbreds in Kentucky

<table>
<thead>
<tr>
<th>Variable</th>
<th>All injuries (n = 618 horses)</th>
<th>p-value</th>
<th>Catastrophic injuries (n = 363 horses)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance: 1 month†</td>
<td>0.95 (0.92, 0.98)</td>
<td>&lt;0.001</td>
<td>0.95 (0.91, 1.00)</td>
<td>0.054</td>
</tr>
<tr>
<td>Distance: 2 months†</td>
<td>0.98 (0.96, 0.99)</td>
<td>0.006</td>
<td>0.99 (0.96, 1.01)</td>
<td>0.339</td>
</tr>
<tr>
<td>0 furlongs during 1 month</td>
<td>1.74 (1.01, 3.00)</td>
<td>0.046</td>
<td>1.41 (0.59, 3.70)</td>
<td>0.443</td>
</tr>
<tr>
<td>0 furlongs during 2 months</td>
<td>4.50 (1.38, 14.61)</td>
<td>0.012</td>
<td>NC**</td>
<td>NC</td>
</tr>
<tr>
<td>Number of high-speed exercise events &gt; 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>furlongs during 2 months prior to the injury race</td>
<td>0.88 (0.77, 1.01)</td>
<td>0.062</td>
<td>0.95 (0.77, 1.16)</td>
<td>0.608</td>
</tr>
<tr>
<td>b1†</td>
<td>0.22 (0.09, 0.52)</td>
<td>&lt;0.001</td>
<td>0.25 (0.06, 1.02)</td>
<td>0.054</td>
</tr>
<tr>
<td>b1/b3†</td>
<td>0.78 (0.60, 0.99)</td>
<td>0.048</td>
<td>0.72 (0.48, 1.10)</td>
<td>0.130</td>
</tr>
<tr>
<td>b1/b6†</td>
<td>0.82 (0.70, 0.95)</td>
<td>0.018</td>
<td>0.87 (0.66, 1.15)</td>
<td>0.329</td>
</tr>
</tbody>
</table>

* Values in parentheses are 95% confidence intervals.
† Distance: 1 month = cumulative distance (furlongs) of high-speed exercise 1 month prior to injury race; Distance: 2 months = cumulative distance (furlongs) of high-speed exercise 2 months prior to injury race; 5 = number of high-speed exercise events > 5 furlongs during the 2 months prior to the injury race; b1, b2, b6 = mean daily distance (furlongs) of high-speed exercise during the 1, 3, and 6 months prior to the injury race, respectively.
** NC = Not calculable because of complete separation (i.e., 0 values in 1 or more cells).

Results

Data were available for 206 injured horses and 412 controls. Risk of injury was inversely associated with cumulative distance of exercise during the 1- and 2-month periods prior to the race in which injury occurred, mean daily rate of distance accumulation during the 1-month period prior to the race in which injury occurred, ratio of the aforementioned rate to mean daily rate of distance accumulation during the 3-month or 6-month period prior to the race in which injury occurred, and the number of high-speed exercise events > 5 furlongs during the 2-month period prior to the race in which injury occurred (Table 1). Accumulating 0 furlongs during the 1- or 2-month period prior to the race in which injury occurred was significantly associated with increased risk of injury, but not catastrophic injury (Table 1).

Discussion

Cumulative high-speed exercise was inversely associated with risk of injury among Thoroughbred horses in Kentucky: the more exercise a horse accumulated, the less likely it was to become injured. We do not believe that decreased amount of high-speed exercise causes injury. Rather, we believe that relatively less cumulative high-speed exercise among injured horses could have been due to preexisting health conditions or musculoskeletal lesions that limited ability to perform high-speed exercise, or due to efforts by trainers to limit high-speed exercise for inclusion in the study. Data regarding age, sex, race-related factors (track surface conditions, class of race, number of starts made by entrant, etc.), and high-speed exercise history were recorded for all horses included in the study. For this study, high-speed exercise referred to officially timed workouts and races; information about daily exercises and unofficial timed workouts were neither included nor available. The following exercise-related factors were recorded for each horse: 1) cumulative distance (furlongs) of high-speed exercise (racing and officially timed workouts) 1, 2, 3, and 6 months prior to injury (or, for controls, date of the race in which the case horse was injured); 2) cumulative number of races 1, 2, 3, and 6 months prior to injury; 3) cumulative number of officially timed workouts 1, 2, 3, and 6 months prior to injury; 4) mean daily distance during the 1, 2, 3, and 6 months prior to injury; 5) number of high-speed exercise events > 5 furlongs during the 2 months prior to the race in which the case horse was injured; and 6) ratio of mean daily distance during the 1-month period prior to injury to mean daily distance for the 2-, 3-, or 6-month period prior to injury. Mean daily distance for the given period (e.g. 3 months) was calculated by dividing the number of furlongs of high-speed exercise accumulated during that period by the number of days in that period, under the assumption that duration of 1 month was 30 days.

Matched sets of injured and control horses were analyzed using the outcomes of all injuries (catastrophic and noncatastrophic categories combined) and catastrophic injuries alone. The crude measure of association between a single putative risk factor and injury was expressed as the odds ratio (OR). The OR were obtained from conditional logistic regression models for matched sets of injured and control horses by use of single variables. Confidence limits for the univariate OR were derived by use of maximum-likelihood estimators. Conditional logistic regression analyses were conducted by use of a commercially available statistical program. A significance level of p < 0.05 was used for analyses.

Discussion

Cumulative high-speed exercise was inversely associated with risk of injury among Thoroughbred horses in Kentucky: the more exercise a horse accumulated, the less likely it was to become injured. We do not believe that decreased amount of high-speed exercise causes injury. Rather, we believe that relatively less cumulative high-speed exercise among injured horses could have been due to preexisting health conditions or musculoskeletal lesions that limited ability to perform high-speed exercise, or due to efforts by trainers to limit high-speed exercise.
exercise in horses with underlying problems. Evidence exists that preexisting lesions may contribute to racing injury.\textsuperscript{3,6} All variables related to increased amount of high-speed exercise were significantly associated with decreased risk of injury (Table 1). None, however, was statistically or clinically superior to the simpler variable of distance accumulated during the 1-month period prior to the race in which injury occurred. The magnitude of this association was small on a per-furlong basis, but a horse with 10 more cumulative furlongs of high-speed exercise during the 1-month period before a race than another horse was nearly 2 times less likely to be injured (alternatively, a horse with 10 less furlongs of high-speed exercise was almost twice as likely to be injured).

Results of this study differ from reports from California indicating that risks of injury is increased with increased accumulation of high-speed exercise during the 1- to 2-month period prior to the index race (the race in which an injury occurred).\textsuperscript{3} The reason for this discrepancy is unknown, but may reflect differences between regions in the populations that were studied, racing surfaces, or training and racing practices. Differences in the high-speed exercise variables between states does not appear likely to be the cause of the discrepancy because each of the high-speed variables examined in Kentucky indicated decreased risk of injury with increased exercise, whereas each of the variables in California indicated increased risk with increased exercise.\textsuperscript{5}

The median number of furlongs accumulated was lower among horses in Kentucky than was reported in California.\textsuperscript{5} This finding may indicate that horses in California accumulate more high-speed exercise than do horses in Kentucky. Alternatively, differences in data collection may explain the difference between regions.

The finding that accumulating 0 furlongs during the 1-month or 2-month periods prior to the race in which injury occurred was consistent with our other results showing that less exercise was accumulated by injured horses, compared with control horses. Lack of exercise may have resulted from preexisting lesions that limited a horse’s ability to withstand or be subjected to high-speed exercise. It is also possible that lack of high-speed exercise caused a decrease in skeletal density, thereby predisposing to skeletal injury. In California, increased duration of lay-up (defined as a period of 60 days or more without high-speed exercise) was associated with increased risk of injury.\textsuperscript{5}

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References and Notes