SELECTED KINEMATIC DIFFERENCES IN THE RUNNING GAIT OF THE GREYHOUND ATHLETE DURING THE BEGINNING AND END OF THE RACE

C. Zebas, R. Gillette, R. Hailey, Y. Joseph, T. Schoeberl
University of Kansas, Lawrence, KS USA

The difference between winning and losing a race may depend on how well an athletecopes with the fatigue factor. Physiologically, this may be related to the training regimen of the athlete. Biomechanically, it may be the adjustments made in technique.

Bates and Haven (1974). Haven (1977), and Richards (1980) have shown that horizontal velocity is decreased during the latter stages of running a race due to fatigue. The reduction in velocity is accompanied by shortened strides (Bates & Haven, 1974; Elliott & Roberts, 1980; Haven, 1977; Richards, 1980; and Sparks, 1974). Bates and Haven (1974) and Haven (1977) found accompanying decreases in stride frequency with long distance sprinters and middle distance runners. However, Elliott and Roberts (1980) and Sparks (1974) found increases in stride frequency with middle distance runners. Richards (1980) found virtually little change in stride frequency with marathoners. Another major fatigue effect was a longer time spent in the support phase of the run (Bates & Haven, 1974; Elliott & Roberts, 1980; and Haven. 1977).

There is another type of sprinting athlete about whom little is known. This is the greyhound racer. Originally brought from Europe by Midwestern farmers to chase unwanted rabbits from the fields. they later became used for sport and now compete in racing events.

The greyhound athlete races around an oval track for a distance of 5/16 mi (502.92m). They begin the race from a starting gate, and then chase a lure around the track. An earlier study by the authors of this study described some of the kinematic parameters of the racing gait To further understand the gait pattern over the course of the race, a second study was undertaken to determine selected kinematic differences in the running gait during the beginning and end of the race.

METHODOWGY

Eleven greyhound athletes from the Woodlands Kennel Club in Kansas City, Kansas were filmed during the schooling races with a LOCAM camera (148 fps) placed perpendicular to the straight-a-way near the finish line. The dogs simulated race conditions by leaving the gate and chasing a lure around the track. After the film was developed. it was digitized and computer analyzed to obtain selected kinematic data related to velocity changes. The parameters selected for investigation were horizontal velocity. stride frequency, smde length. total support time, front leg support time, rear leg support time. total flight time, front leg flight distance, and rear leg flight distance. Paired t-tests were performed on each kinematic parameter between the two conditions. Significance was determined at the $p < .05$ level.

RESULTS AND DISCUSSION

The kinematic changes from beginning to end of the race are shown in Table 1. Significant differences also are indicated.

Table 1
Kinematic Changes at the Beginning and End of the Race.

Parameter	Beginning	End	
Horizontal velocity	16.45 m/s	14.58 m/s	*
Stride frequency	3.25 str/s	2.82 str/s	*
Stride length	5.06 m	5.17 m	NS
Total support time	.187 s	.225 s	*
Front leg support time	.093 s	.114 s	*
Rear leg support time	.093 s	.116 s	*
Total flight time	.122 s	.130 s	NS
Front leg flight distance	1.23 m	1.42 m	*
Rear leg flight distance	2.50 m	2.32 m	*

* $p < .05$

There is little information available on greyhound racing. Most of the animal literature describes normal or pathological gait. Therefore. the following discussion will compare human runners with greyhounds under fatigue conditions.

Just as in human runners (Bates & Haven, 1974; Haven, 1977; and Richards, 1980). greyhound runners also decrease overall horizontal velocity from beginning to end of the race. However. whereas stride length in humans generally decreases with fatigue (Bates & Haven, 1974; Elliott & Roberts, 1980; Haven, 1977; Richards, 1980; and Sparks. 1974). the stride length in greyhounds remains unchanged. Even though the overall smde length does not change, the step length does. This is indicated by rear leg flight distance which decreases significantly and front leg distance which increases significantly. This is in disagreement with Alexander and Goldspink (1977) who said that mammals increase stride length as they increase their speed, but keep the step length fairly constant.

The stride frequency decreases significantly in greyhounds from beginning to end of the race. This is not unlike the human runner in the longer sprint races who does the same (Bates and Haven, 1974 and Haven, 1977). In longer races with humans, the stride frequency increases (Elliott and Roberts, 1980 and Sparks, 1974), or remains the same (Richards, 1980).

Support times in greyhounds increase significantly from beginning to end of the race. This includes total support time as well as front and rear leg support times. This is similar to human runners who also increase support time toward the end of the race (Bates and Haven, 1974; Elliott and Roberts, 1980; and Haven, 1977). There was no significant change in the total flight time of the greyhounds.

Overall horizontal velocity in the greyhounds decreased because the stride frequency decreased with little or no accompanying changes in stride length. It would appear the back legs absorbed more energy later in the race which limited the amount of stored elastic energy available to project the dog forward. This is evidenced by the fact that more time was spent in ground support than in flight. Even though the push off generated by the back legs allowed the overall stride length to remain unchanged, the ratio of rear leg flight distance to front leg flight distance decreased.

Alexander, Dimery, & Kerr, (1985) described the galloping stride of a quadruped in terms of energy changes. In the initial foot strike the front legs are doing negative work, removing energy from the body. As the body mass is driven forward over the front legs and the rear legs are moving forward under the body, positive work is being performed, thus restoring energy. When the rear legs touch the ground under the body, negative work with the resulting loss of energy occurs again. Then, when the rear legs push off, positive work and energy restoration begins. When the four legs are situated under the body during the flight phase, the spine of the dog is bent into a smooth curve. The longissmus muscle is stretched and acts as a spring that stores and returns internal kinetic energy. When the rear leg flight distance is reduced as it was in this study, the "spring" is not as effective in restoring energy.

CONCLUSIONS

It was concluded that a fatigue effect or the inefficient use of the stored elastic energy in the rear legs is occurring in the greyhound athletes from the beginning to the end of the race. This may have implications for future training programs.

ACKNOWLEDGMENT

This study was supported by a grant from the Kansas Racing Commission.

REFERENCES

Alexander, R. Mc. (1980). *Elastic mechanisms in animal movement.* New York: Cambridge University Press.

Alexander. R. Mc. and Goldspink, G. (1977). *Mechanics and energetics of animal locomotion.* London: Chapman Hall.

Alexander, R. Mc., Dimery, N. J.. and Kerr, R. F. (1985). Elastic structures in the back and their role in galloping in some mammals. *Journal of Zoology, 207A*, 467-482.

Bates, B. T. and Haven, B. H, (1974). Effects of fatigue on the mechanical characteristics of highly skilled female runners. In R. C. Nelson and C. A. Morehouse (Eds.), *Biomechanics IV*, (pp. 119-125). Baltimore: University Park Press.

Elliott, B. C. and Roberts, A. D. (1980). A biomechanical evaluation' of the role of fatigue in middle-distance running. *Canadian Journal of Applied Sport Science, 5*(4), 203-207.

Haven, B. H. (1977). *Changes in the mechanics of the running patterns of highly skilled women runners during competitive races.* Unpublished doctoral dissertation. Indiana University. Bloomington.

Sparks, K. E. (1974). *Physiological* and *mechanical alterations due to fatigue while performing a four-minute mile.* Unpublished doctoral dissertation. Indiana University, Bloomington.