LITERATURE SURVEY OF RACING GREYHOUND INJURIES, PERFORMANCE AND TRACK CONDITIONS

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SUMMARY
A literature survey was carried out to determine the type of research that has already been undertaken on the influence of the track surface conditions and design on the performance and susceptibility to injury of racing greyhounds. Greyhound research is dominated by veterinary literature regarding the incidence and treatment of injuries, however little research has been carried out on the causes of injuries relating to the track surface. This brief literature review outlines some of the main areas of research on greyhound racing and focuses on the influences of track characteristics on the racing greyhound. The need for research on greyhound racing tracks in the United Kingdom is also highlighted.

INTRODUCTION
The safety and performance of the racing greyhound is of great concern to dog owners, trainers, race promoters and veterinarians. Among other factors, the surface of a greyhound racing track may affect both the performance and the susceptibility to injury of the racing dogs. Indeed, studies on other racing animals have shown that the condition of racing tracks can influence their performance in terms of producing faster running times. Field et al. (1993) found a negative relationship between the penetration resistance (or strength) of the soil and the winning time for horses, indicating that stronger soils produce faster winning times. The penetration resistance of these tracks was found to be related to both the degree of soil pore saturation and the bulk density of the soil. The relationships showed that wetter soils provided lower penetration resistances and therefore slower winning times for horses and the soils with greater bulk density provided greater penetration resistances and therefore faster winning times (Field et al. 1993). Similar findings were reported by Zebarth & Sheard (1985) who studied the relationship between impact resistance and the shear strength of the race track surface to the performance of racing horses. They found that the winning race time decreased with an increase in track hardness and that hardness was found to increase with increasing soil bulk density but decrease with increasing soil moisture content thus affecting the race time accordingly. Zebarth & Sheard (1985) also found that the particle size distribution of the track material had an influence on both surface hardness and shear strength. Sandy materials were harder and had lower shear strength than soil surfaces with greater silt and clay contents (Zebarth & Sheard 1985). This and other work on horse racing tracks show that many of the characteristics of the track material can influence the speed of the track. It is likely that such track surface properties will have similar effects on the racing performance of greyhounds. Moreover, it is also likely that the track surface may influence the incidence of injury to the racing animal as was found for lameness in horses (Cheney et al. 1973).

Much has been written about the injuries that can occur in racing greyhounds and the treatment of them, but less has been written about the causes of racing injuries and how the track surface and design may influence the number and types of injuries occurring. Moreover, little has been written about the influence of the track surface and the performance of racing greyhounds. The following comprises a brief review of some of the literature concerned with greyhound injuries, performance and racing track conditions.
COMMON INJURIES OF THE RACING GREYHOUND AND INJURY SURVEYS

Racing greyhounds are at risk from suffering injury during their racing career. Such injuries can vary in both severity and cause. Muscle injuries can occur when the greyhound runs due to over extension especially if the dog is not “warmed up” properly before the race (Kohnke 1991). Rapid acceleration from a standing start to up to 64 km (40 miles) per hour within seconds can exert massive strain on the muscles (Kohnke 1991). Other common injuries occur in the foot of a greyhound where the animal comes into contact with the racing track surface. Injuries such as torn or broken toe nails can be easily treated but if left they can become infected and cause inflammation (Davis 1967, 1977). Damage to the pads of the foot can occur if the thick layer of skin on the pad wears thin and becomes sore and cracked, especially when the dog trains and races on hard surfaces (O’Conner 1988). The webbing between the toes of a greyhound may also become injured during racing (Power 1975), especially when the dog is running as this spreads the foot exposing the webbing and leaving it susceptible to being cut or split (O’Conner 1988).

General toe injuries were found to cause 43% of greyhound lameness in a survey of approximately 600 track injuries conducted by Warpole (1947). A later survey of greyhound injuries over one year from two London tracks was carried out by Prole (1976). Of the 786 injuries reported by Prole (1976), 44% were in the foot region (fore and hind legs combined), 95% of which were toe injuries. Moreover, 21% of all injuries occurred in the carpus (wrist) and metacarpus (between toes and wrist) regions of the fore leg and approximately 6% in the tarsus (hock) and metatarsus (between toes and hock) of the hind leg (Prole 1976). The greyhounds included in the surveys by Warpole (1947) and Prole (1976) ran on grassed tracks and Prole (1976) made the observation that the number of injuries throughout the year changed with the weather patterns. He observed that under dry weather conditions injuries on the track increased compared with wet conditions. From this, Prole concluded that the track surface became harder in dry conditions allowing the greyhounds more grip thus providing a faster racing surface and a greater incidence of injuries due to greater stresses on bones and muscles.

A survey of greyhound injuries on three tracks in the US between 1984 and 1988 is reported by Bloomberg (1989). The tracks were of different sizes but the surface material of all three tracks comprised a 90:10 mix of sand and clay. In contrast to the surveys taken from turf tracks, 56% of all injuries on these sand-dominated tracks were tarsal and only 6% of the total were toe injuries (Bloomberg 1989). Moreover, there was a general tendency for the number of tarsal injuries to increase with each successive race (Bloomberg 1989) suggesting that the disturbance of the surface from previous races may have brought about subsequent injury.

Similar results were also seen in another survey of racing greyhound injuries conducted by Bloomberg & Dugger (1991) at six tracks in Florida between 1984 and 1990. They reported that 52% of all injuries were to the tarsus and that tarsal injuries tended to increase with each successive race in a thirteen race programme. Moreover, the first race in the programme was found to have significantly (P<0.05) less tarsal injuries than the subsequent races (Bloomberg & Dugger 1991). However, no statistically significant relationship was found between racing position of the dogs (1 to 8 across the track) and the number of injuries sustained. This suggests that dogs with starting positions closer to the inner rail were as equally susceptible to becoming injured as those near the outside rail (Bloomberg & Dugger 1991). However, no mention of the track surface conditions or maintenance procedures was made in this report.

A further race track injury survey by Bloomberg (1995) of twelve tracks between 1990 and 1994 showed that the majority of injuries recorded were tarsal and represented 43% of all injuries, rather that 52% as recorded in the previous survey by Bloomberg & Dugger
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(1991). Bloomberg (1995) argued that such a decrease in injuries to the tarsus may be a result of the greater degree of surface banking at the turns on the tracks of the most recent survey compared with the previous one.

TRACK DESIGN AND GREYHOUND INJURIES
Bloomberg (1989) cited data from an American Greyhound Track Operators’ Association report compiled in 1977 which surveyed greyhound racing tracks in the United States. The data presented show that 13 out of 30 tracks ranked the first turn on the track as the area in which the greatest incidence of injuries occurs (Bloomberg 1989). As greyhounds accelerate from the starting position they negotiate the first turn at speed and are immediately forced to change direction. The dogs become subject to centrifugal force around the bends and so they lean toward the inner rail of the bend to counter the force and maintain their speed (Ireland 1989). The lean of the dog means that the joints of the legs, especially the tarsus, are subject to horizontal strain when they are only designed to move excessively in the vertical plane, therefore for large horizontal loads on the joints may cause fractures or tissue damage (Gillette & Zebas 1991). Banking the track surface at the turn would ease the centrifugal force acting on the dogs. Ireland (1989) found that increasing the slope of a track around the bends allowed speed to be maintained at a reduced lean for the greyhound.

Calculations by Gillette & Zebas (1991) show that if a greyhound of an average weight of 32 kg ran at 64 km (40 miles) per hour around an unbanked turn with a 40 m radius, it would mean that a horizontal force of 25 kg would be acting on the leg joints. Gillette & Zebas (1991) calculated that to negate this force, the turn would have to be banked at 38°. In reality a 38° slope on a track approximately 6 m wide would mean that the outer rim would be approximately 4.7 m above the inner rim of the track which would be almost impossible to maintain especially in wet weather when problems with material erosion would be likely.

Moreover, if a dog slips on such a high banking, it is more likely to fall down the bank and into the path of other dogs possibly causing further injury (Bloomberg 1989). However, any degree of banking at the turns will reduce the horizontal force that acts mainly on the tarsus, for example a bank of 7° would reduce the horizontal force by approximately 16% compared with an unbanked turn (Gillette & Zebas 1991).

Bloomberg (1989) observed that a track that had raised the banking of the first turn “by several inches” reduced injury numbers by 53% in one racing season. Bloomberg (1989) argued that the first turn on a track should be steeper because it is at this point when the dogs are usually at their greatest speed. Subsequent turns need not be as steeply banked because the speed of the greyhounds tends to lessen as the race progresses (Bloomberg 1989).

In addition to reducing injuries on a turn, banking allows a redistribution of forces exerted by the greyhound. Gillette & Zebas (1991) stated that less of the greyhound’s energy will be used to stay on the turn if it is banked, therefore leaving the dog more energy to propel itself.

GREYHOUND BIOMECHANICS AND THE TRACK SURFACE
The study of the way in which a greyhound runs is fundamental in highlighting the importance of desirable track surface characteristics. Four stages in the running pattern of a greyhound have been identified (Gillette & Zebas 1991; Zebas et al. 1991), and these comprise two support phases and two flight phases. The front support phase is where the greyhound lands on its front feet from the rear flight phase. For approximately 84% of greyhounds running in a straight line, the first landing foot is the left followed by the right foot landing a pace infront, however, the two front feet are rarely in contact with the track simultaneously (Gillette & Zebas 1991). The front support
phase is followed by the front flight phase in which the front legs of the dog are raised and there is no contact between the track and the greyhound at all. The greyhound then lands on the track in the rear support phase in which the right rear leg then the left rear leg support the weight of the greyhound. From this position the greyhound propels itself forward and enters the rear flight phase when the dog is in full flight until it lands on its front legs in the front support phase again (Gillette & Zebas 1991).

The circular sequence of foot landing for most greyhounds (front left foot, front right, rear right then rear left foot) is reflected in the injury data found in surveys that made the distinction between the four greyhound legs. Warpole (1947) reported that all injuries in his survey were distributed thus: 40% front left leg, 29% front right leg, 19% rear right leg and 12% rear left leg. Prole (1976) found a similar distribution in his survey with 46%, 28%, 18% and 8% of injuries found on the front left, front right, rear right and rear left legs, respectively. The force at which the foot of the leading leg impacts the track is approximately 2.2 times the body weight of the greyhound (Gillette 1991) after the rear flight phase which is the power behind the forward movement of the dog. Thus it is would seem that the left leg that absorbs the largest impact and therefore would be more likely to suffer jar- ring, fractures, muscular strains and other injuries. The subsequent landing feet in the sequence may then suffer less of an impact and therefore suffer less injury.

Gillette & Zebas (1991) reported that even if a small proportion of greyhounds lead with their right foot on the straight stretches of the track, 100% of the greyhounds observed led with their right leg on the turns although no explanation of why this might be was given. Thus it would seem that for the great majority of greyhounds, a change in footing takes place when they enter a turn. This may be a factor influencing the observation that many injuries occur on the turns. If a greyhound loses footing whilst the leading foot is changed then this could lead to injuries.

It is important that the greyhound establishes a good footing so that a controlled running patterned can be maintained by the dog. Gillette & Zebas (1991) calculated the average distance covered by a running greyhound through one cycle of its racing gait (i.e. once through all four phases). They found that 14% of the distance was covered when the dog was in the front support phase, 24% of the stride distance was in the front flight phase, 12% in the rear support phase and 50% in the rear flight phase. This means that on average, a greyhound is in flight for 74% of its stride distance. Therefore, the greyhound is in contact with the track surface for only 26% of the stride distance. Moreover, it is only when the foot is in contact with the track that the greyhound can navigate a route around the track (Gillette & Zebas 1991), thus highlighting the need for good and consistent track conditions.

**TRACK MAINTENANCE**

Inconsistencies in the track surface are dangerous for greyhounds because they are not capable of safely adjusting to various surface conditions on the track and so injuries can occur (Gillette 1992). Many track inconsistencies are due to poor maintenance as well as track materials. Uneven watering of the surface can cause soft patches in some areas and loose, dry patches in others, however, variable drainage rates across the track may also be affected by the type of underlying layer and its permeability. Water is needed in a sandy medium because the surface tension of the water between the particles offers a cohesive surface on to which a greyhound foot could grip. If a track material is waterlogged when racing commences, then there will be negligible friction between the sand particles and the surface will be soft underfoot and offer little traction. Moreover, if the track surface is too dry, then the sand grains will be loose with no cohesion thus also offering little grip (Gillette 1992).

Gillette (1992) argued that a good track for racing comprises two layers. The upper layer
of the sand should act as a cushion to the impact of the greyhound's feet, thus absorbing some of the energy. The base layer, should be firmer than the top, thus offering the traction needed for controlled running, and a platform from which the dog can propel itself (Gillette 1992). Gillette (1992) argued that the depth of the upper layer is critical, because if too deep, the foot will not contact the traction layer and footing may be lost and injuries may occur due to over extension. Moreover, if the cushion layer is too shallow, then the foot will hit the traction layer and the leg will absorb the full force of the impact. Gillette (1992) did not indicate in his report what the ideal depth for the cushion layer should be.

Bissett (undated) suggested that this upper layer should be prepared by using either a power harrow or blades supported by a rectangular frame that can cut to approximately 50 mm depth. These types of equipment can be easily pulled by a tractor, thus disturbing the surface of the track and breaking up any compacted areas. This layer should then be left to dry, and a flat plate dragged over it the smooth and firm the surface. However, even though the surface layer may appear uniform, this is of no use if the base layer is not of a uniform depth from the surface (Gillette 1992). To ensure that the base layer is uniform, Bissett (undated) suggested that the sand material should be cut with blades of approximately 150 mm in depth every 7-10 days so that no part of the track is left undisturbed. The sand must then be compacted either with a heavy plate or a roller to firm the traction layer. After this, the cushion layer can be prepared at the surface prior to racing (Bissett undated).

RESEARCH NEEDS

The literature indicates that the relationship between greyhound performance and injury with the track surface conditions has not been extensively investigated. Little scientific research has been undertaken in this field, however inferences have been made regarding the influences of track surface conditions but these have been largely anecdotal. This may be because of the difficulties involved in both assessing which particular track characteristics would be desirable and the practicality of easily measuring track performance criteria.

It is likely that different types of track materials will offer different racing conditions. In the United Kingdom, little is known about the materials or characteristics of the tracks that are already in existence. Most of the tracks have sand materials at the surface however, a large range of sand types may exist nationwide. There is an obvious need to catalogue the construction materials of these tracks and to attempt to relate track materials to certain performance criteria. This may then indicate which materials may offer the most ‘desirable’ track characteristics for greyhounds in terms of both performance and safety. Preliminary research addressing some of these issues has been undertaken and is reported later in this volume (Cook & Baker 1998a, b).

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REFERENCES


