Short Communication

Small and medium agility dogs alter their kinematics when the distance between hurdles differs

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Abstract

There is currently a lack of research examining the health and welfare implications for competitive agility dogs. The aim of this study was to examine if jump kinematics and apparent joint angles in medium (351 mm – 430 mm to the withers) and small (< 350 mm to the withers) agility dogs altered when distances between consecutive upright hurdles differ. Dogs ran a course of nine hurdles; three set at 3.6 m apart; three at 4 m apart and three at 5 m apart. Both medium ($P = 0.044$) and small ($P = 0.006$) dogs landed closer to the hurdle when consecutive hurdles were set at 3.6 m apart, with small dogs jumping slower at this distance ($P = 0.006$). Results indicate that jump kinematics, but not apparent joint angles, alter when the spacing between hurdles differs. These findings may have implications for the health and welfare of agility dogs and should be used to inform future changes to rules and regulations.

Keywords: canine, biomechanics, welfare

Introduction

Dog agility is a sport, testing both the dog's fitness and the owner's ability to navigate a predetermined course in the fastest time with the least faults. Within the UK, interest in the sport is growing rapidly, with one competition seeing entries increase annually, from 2,200 dogs in 2013 to 2,700 dogs in 2014 (The Kennel Club, 2014). With this increasing popularity and participation, research is required to investigate the long term health and welfare implications for the canine athlete.

Due to the increasing popularity of agility, the physical demands placed upon the canine athlete to progress in the sport are increasing. This observation, coupled with an increased knowledge of injury risks (O'Cannapp, 2007; Levy et al., 2009; Cullen et al., 2013), suggests that scientific research is required to inform and develop existing regulations in contrast to them being based on arbitrary figures. In the UK, The Kennel Club (KC) is the major governing body of agility competitions, with the minimum distance between consecutive obstacles in a straight line currently set at 3.6 m (The Kennel Club, 2014). Conversely, under Federation Cynologique Internationale (FCI) regulations, the minimum distance between obstacles varies based on the dog's height classification; 4 m for small dogs and 5 m for medium and large dogs (FCI, 2012). To date, no research has examined how the distance between obstacles affects the jump kinematics of small and medium dogs and correspondingly how this may affect the health, welfare and active longevity of the dog.

A recent study by Birch et al., (2015) examined the effects altering distances between hurdles had on the jump kinematics of large agility dogs (> 431 mm at the withers). Significant differences were observed, with dogs taking off and landing closer to the hurdle when consecutive jumps were spaced at 3.6 m apart compared to 5 m apart. Additionally there were significant differences in apparent neck, back and shoulder angles upon landing when hurdles were spaced at 3.6 m apart (Birch et al., 2015). These observations might, in part, explain why injuries in agility dogs are commonly reported in these locations (Cullen et al., 2013; Levy et al., 2009; O'Cannapp, 2007).

As a consequence of kinematic differences being identified in large agility dogs, the aim of this study was to examine whether medium (351 mm – 430 mm to the withers) and small (< 350 mm to the withers) agility dogs also demonstrated altered jump kinematics as the distance between hurdles altered. Specific areas of study were: (1) how take-off distance, landing distance and speed altered when the distance between hurdles increased in medium (n =17) and small agility dogs (n = 11), (2) how apparent neck, lumbar spine and shoulder angles differed between the three distances and (3) how this compares to existing findings in large agility dogs.

Materials and Methods

The study was undertaken in accordance with Birch et al., (2015), analysing data collected at The Kennel Club International Agility Festival, 2013. The study gained full ethical approval from Nottingham Trent University's School of ARES Ethical Review Group (ARES 60, 2/10/2012). All dogs had a veterinary screening prior to being tested with no dogs being withdrawn from the study (Table 1: Breed demographics). Dogs were filmed using high definition video cameras (JVC GC-PX10 HD, 300fps) over nine upright hurdles: three set at 3.6 m apart, three at 4 m apart and three at 5 m apart (Figure 1A: Layout of hurdles used in the study). Each dog ran the course of nine hurdles once, being stopped and restarted between each set of three hurdles. The height of the jump was set in relation to current KC regulations; small dogs jumped a hurdle set at 350 mm and medium dogs jumped a hurdle set at 450 mm. Each dog was tested in the height category that it normally competed in with handlers advised to run their dogs as they would during competition.

Data analyses were conducted using Dartfish software (Dartfish, 2014; Figure 1B: Mean take-off and landing distance for medium dogs over the 3.6 m distance. Figure 1C: Mean take-off and landing distance for medium dogs over the 5 m distance) and were analysed independently by two researchers. Linear distances and apparent joint angles were measured in single frames from the video, with the foot of the hurdle wing (0.48 m) being used to calibrate distances. Take-off was determined as the frame immediately prior to the dog leaving the ground and was measured from the hurdle wing to the tip of the trailing hind limb toe. Landing was determined as the frame immediately after the dog first makes contact with the ground and was measured from the back of the leading carpus to the hurdle wing. The bascule phase was determined as when the dog was midpoint over the jump (Powers, 2002).

The apparent neck, back and shoulder angles were measured during the take-off, bascule and landing phase of the jump. Apparent neck angle was that which formed between the top of the skull, C2 and the top of the scapula. Lumbar spine angle was that which formed between T13, the top of the ilium and the base of the tail. Shoulder angle was that which formed between the top of the scapula, top of the humerus and the elbow. Pearson correlations assessed inter-observer reliability and one way analysis of variance (ANOVA) was used to assess for any differences. Tukey's post hoc tests determined where the differences lay with means (± standard error) used to report these differences.

Results

There were high levels of inter-observer reliability for take-off and landing distances (medium; $r[78] = .989$, small; $r[72] = .990$, $P < 0.001$) as well as for apparent joint angles (medium; $r[381] = .865$, small; $r[297] = .888$, $P < 0.001$). Significant differences were seen in landing distances for both medium ($F[2,48] = 3.338$, $P = 0.044$) and small ($F[2,33] = 5.954$, $P = 0.006$) dogs between the 3.6 m, 4 m and 5 m distances. Tukey's post hoc tests revealed medium dogs landed significantly nearer to the hurdle in the 3.6 m distance compared to the 5 m distance (3.6 m; 0.83 m ± 0.06, 5 m; 1.09 m ± 0.08, $P = 0.035$). Small dogs also landed nearer to the hurdle during the 3.6 m distance compared to the 5 m distance (3.6 m; 0.6 m ± 0.06, 5 m; 0.93 m ± 0.07, $P = 0.005$). (Figure 2A: Mean landing distances for small and medium dogs).

When examining speed, landing speed differed for small dogs ($F[2,30] = 6.061$, $P = 0.006$) with Tukey's post hoc tests revealing dogs land faster during the 5 m (5.42 m/s ± 0.25) distance compared to the 4 m (4.49 m/s ± 0.25) and 3.6 m (4.31 m/s ± 0.24) distance ($P < 0.05$) (Figure 2B: Mean landing speeds for medium and small dogs).

Discussion

This study demonstrated very high levels of inter-observer reliability adding to the validity of the study. The findings suggest medium and small dogs demonstrate similar jump kinematics to large agility dogs, whereby dogs land closer to the hurdle when consecutive hurdles are closer together (Birch et al., 2015). The similarity in take-off distance for medium (3.6 m; 1.14 m ± 0.08, 4 m; 1.22 m ± 0.08, 5 m; 1.25 m ± 0.06, $P > 0.05$) and small (3.6 m; 1.06 m ± 0.05, 4 m; 1.02 m ± 0.05, 5 m; 0.91 ± 0.06, $P > 0.05$) dogs could potentially be a consequence of the distance between hurdles being proportionately greater for them in comparison to large dogs. Indeed, large dogs typically 'bounced' (i.e. did not add a stride) between the 3.6 m hurdle distance compared to medium and small dogs who were able to include additional strides. Powers (2002), identified that successful show jumping horses take off further from the jump during a puissance competition compared to unsuccessful horses. Thus, medium and small dogs, due to their ability to add strides between hurdles, may be more able to adopt an optimum take-off distance compared to large dogs at the 3.6 m distance. When examining medium dogs, landing distance differed significantly but speed did not. This potentially could lead to larger impulses upon landing in supporting the dog's body mass against gravity. This illustrates how the distance between hurdles has potential for health and welfare implications in medium dogs.

There were no significant differences in apparent joint angles between the three distances ($P > 0.05$) for either medium or small dogs. This observation may be a consequence of the wide diversity of breeds within medium and small height categories. Within the medium and small height categories, 32% were cocker spaniels and 32% terriers, with the remaining 36% consisting of other breeds. In contrast, 80% of large dogs in Birch et al., (2015) study were border collies and working sheepdogs, illustrating the larger diversity of breeds in small and medium height classifications. Anecdotally, there are breed and conformational differences in jumping styles, with this divergence likely being reflected in the large standard deviations of apparent joint angles for these dogs. Indeed, the high rate of inter-observer reliability supports the notion of different jumping styles, as opposed to an increased difficulty in measuring apparent joint angles for small and medium dogs. One study has previously identified that forelimb conformation differed significantly between elite and non-elite agility border collies illustrating that differences in conformation may affect jumping ability even within the same breed (Birkbeck et al., 2012).

The findings from this study support previous research and add to the knowledge of how spacing between hurdles alters the kinematics of agility dogs. It would be useful to determine breed specific jumping profiles in healthy agility dogs for future research as well as assessing if level of ability impacts upon take-off and landing distances in medium and small dogs. The research suggests that competitive rules and regulations should no longer be based upon arbitrary figures and rather, on scientific observations to ensure optimum canine health and welfare.

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Appendix

Table 1: Breed demographics

Height category	**Breed Type**	**Number of dogs**
Medium	Spaniel (cocker & springer)	6
Medium	Terrier	4
Medium	Miniature poodle	1
Medium	Kelpie & border collie	3
Medium	Duck tolling retriever	1
Medium	Miniature schnauzer	1
Medium	Shetland sheepdog	1

Small	Spaniel (cocker)	3
Small	Toy poodle	1
Small	Terrier	5
Small	Swedish vallhund	1
Small	Bassett fauvre de bretagne	1

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