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Papers

Risk factors for tail injuries in dogs in Great Britain

G. Diesel, D. Pfeiffer, S. Crispin, D. Brodbelt

The aim of the current study was to quantify the risk of tail injury, to evaluate the extent to which tail docking reduces this risk, and to identify other major risk factors for tail injury in dogs in Great Britain (GB). A nested case-control study was conducted during 2008 and 2009. Data were obtained from a stratified random sample of veterinary practices throughout Great Britain, and questionnaires were sent to owners of dogs with tail injuries and owners of a randomly selected sample of dogs without tail injuries. The risks of injury were reported adjusting for the sampling approach, and mixed effects logistic regression was used to develop a multivariable model for risk factors associated with tail injury. Two hundred and eighty-one tail injuries were recorded from a population of 138,212 dogs attending 52 participating practices. The weighted risk of tail injuries was 0.23 per cent (95 per cent confidence interval 0.20 to 0.25 per cent). Thirty-six per cent of injuries were reportedly related to injuries sustained in the home, 17.5 per cent were outdoor-related injuries, 14.4 per cent were due to the tail being caught in a door, for 16.5 per cent the cause was unknown and the remainder were due to other causes. Dogs with a wide angle of wag and dogs kept in kennels were at significantly higher risk of sustaining a tail injury. Dogs with docked tails were significantly less likely to sustain a tail injury; however, approximately 500 dogs would need to be docked in order to prevent one tail injury. English springer spaniels, cocker spaniels, greyhounds, lurchers and whippets were all at significantly higher risk when compared to labradors and other retrievers. Differences between countries (England, Scotland and Wales) and between rural and urban environments were not significant.

THE docking of dogs' tails remains controversial and centres on whether non-therapeutic docking reduces the risk of tail injury sufficiently to justify the ethical concerns of a prophylactic intervention (Orlans and others 1998, Bennett and Perini 2003). A ban on non-therapeutic tail docking was introduced in Great Britain in early 2007. In Scotland, a complete ban was introduced, in Wales the ban was introduced with specific working breed exemptions, and in England the ban was introduced with specific working breed-type exemptions (Anon 2006, Defra 2007). The exemptions include dogs involved in law enforcement, the armed forces, emergency rescue, lawful pest control and lawful shooting of animals. These variations in legislation provided a unique opportunity to evaluate the association between docking and tail injuries in a population of dogs including substantial numbers of docked and undocked animals, and to assess whether country (England, Scotland or Wales) and location (rural or urban) are risk factors in themselves.

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G. Diesel, BVSc, MSc, PhD, MRCVS,
D. Pfeiffer, DrMedVet, PhD, MACVSc, DipECVPH,
D. Brodbelt, MA, VetMB, PhD, DVA, DipECVAA, MRCVS,
Department of Veterinary Clinical Sciences, Royal Veterinary College, Hawkshead Lane, North Mymms, Hertfordshire AL9 7TA
S. Crispin, MA, VetMB, BSc, PhD, DVA, DVOphthal, DipECVO, FRCVS,
Department of Anatomy, University of Bristol, University Walk, Clifton, Bristol BS8 1TD
E-mail for correspondence: gilldiesel@yahoo.co.uk

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A previous study conducted in Edinburgh in 1985 showed that tail injuries were rare, with the estimated prevalence being 0.39 per cent (Darke and others 1985). That study estimated that not docking a dog's tail increased the risk of a tail injury 1.28 times, but this was found to be not significant (95 per cent confidence interval [CI] 0.61 to 2.69 per cent). A more recent survey, which recorded the types of injuries and causes of lameness in dogs involved in game shooting, showed a highly significant association between tail injuries and being undocked among springer spaniels (P=0.008) and cocker spaniels (P=0.004) (Houlton 2008). Both these studies represented a subset of the dog population in Great Britain and were conducted before implementation of the restrictions on docking. Additionally, the study by Houlton (2008) of working dogs relied on a convenience sample, and the study by Darke and others (1985) is more than 20 years old; therefore, further work to evaluate tail injuries in Great Britain was considered necessary. The aim of this study was to quantify the risk of tail injuries, to ascertain the extent to which docking reduces the risk of tail injury, and to identify other major risk factors for tail injury in dogs attending veterinary practices in Great Britain.

Materials and methods

Participants and procedure

A case-control study design was used nested within a cohort of dogs attending veterinary practices between March 2008 and March 2009. Power calculations carried out before the study estimated that approximately 250 dogs with tail injuries would be required. However, these calculations were revised on the basis of preliminary estimates of the prevalence of dogs with docked tails among the dogs recruited into the study. The revised sample size calculations estimated that approximately 90 to 120 cases of tail injury would be required based on the detection of an odds ratio of 0.3 to 0.5, assuming that the prevalence of docking among dogs was approximately 12 to 14 per cent (95 per cent confidence level, 80 per cent power, case:control ratio of 1:4) (Win Episcope 2.0; CLIVE).

A list of mixed and companion animal veterinary practices was taken from the Royal College of Veterinary Surgeons Practice Register (RCVS 2008). This list was stratified by country (England, Scotland or Wales,) and then the list for each country was stratified by location (rural and urban) based on the postcode classification of the practice location (Office for National Statistics 2006). A sample of veterinary practices was then randomly selected, using random number generation, from each of these lists. The practices in the sample were approached to determine whether they were using one of seven specified computerised practice management systems (RoboVet or PremVet [Vet Solutions], Midshires or Ventana [Cosulsoft], Teleos [Teleos Systems], Vet-one [Gemhader Software] and RxWorks [RX Works]), and whether they were willing to participate in the study. Data were extracted from the practice database of all participating practices, to obtain a list of all dogs that had attended the veterinary practice in the previous 12-month period and their clinical histories. A free-text search was used to identify all dogs that had sustained a tail injury by searching for the word 'tail'. The search detected all words containing 'tail' whether there was a space or not before or after the word.

Cases were defined as any dog presented to the veterinary practice within the previous 12 months for treatment of a tail injury, including fractures, dislocations, lacerations, contusions, self-trauma and neoplasia. Tail problems relating to neoplasia and self-trauma were included as it has been reported anecdotally that in some of these cases there is an underlying chronic traumatic injury that eventually leads to the development of a tumour or a self-traumatic injury. A list of all dogs that had attended each of the participating veterinary practices during the same one-year period as the case dogs was obtained, and control dogs were then randomly selected from this list by random number allocation. For each case, approximately four control dogs were randomly selected. Dogs selected as controls that had sustained a tail injury within the past 12 months but had not been treated by a veterinarian were excluded as controls. Dogs suffering from water tail/limber tail were excluded from the study as these injuries are not well understood and it is thought that they are due to muscle fatigue. It was also thought that including these dogs as cases would result in a weakening of the power of the study and the possibility of examining associations between risk factors and typical tail injuries.

Questionnaire design

The owners of the selected cases and controls were sent a questionnaire during 2008 and 2009. The questionnaire was designed and pretested before the study. The questionnaire was reviewed by five epidemiologists and eight clinicians. It was then pretested on five dog owners to ensure it was clear and easy to follow. The questionnaire was also translated into Welsh. A prepaid reply envelope was supplied with the questionnaire, in addition to a disposable tape measure to enable owners to measure the length and height of their dog. The questionnaire investigated aspects relating to the size, temperament (as perceived by the owner) and breed of the dog, the home environment, whether the dog was used as a working dog and the nature of any tail injuries (Table 1) (questionnaire available on request from GD). Tail wag angle was assessed by asking the owners to estimate how far the tail deviated from the midline position by selecting one of three options provided in the form of a diagram. Dog owners who returned their questionnaire were entered into a monthly prize draw in order to increase the response rate. A second questionnaire and reminder letter were sent to all owners if no response was received within four weeks.

Data analysis

All data were entered into a predesigned database with data entry validation rules (Access 2003; Microsoft). The data were checked, cleaned and then exported to Stata version 9 (Stata Corp) for analysis.

TABLE 1: Risk factors evaluated in a case-control study of tail injuries in dogs in Great Britain

Factor	
Dog characteristics	Age, sex, neuter status, breed, weight, height, tail length, body length, coat length, coat type, body condition, docked before injury, tail shape, tail hair, temperament, tail wag angle, tail wag in circles, bottom wag, style of tail wag
Owner details/type of activity	Country, urban/rural, veterinary practice, uses dog for work, shows dog, where is dog kept, type of property, how many other dogs owned, frequency of exercise, exercise hours, exercise environment, type of work, frequency of work, work hours, work environment

The weighted risk estimates were calculated accounting for the sampling strategy by using the Stata 'survey' commands. Additional risk approximations were calculated for working and non-working dogs, for docked and non-docked dogs, and for individual breeds or breed types based on estimated denominator data. This was calculated by using the proportion calculated from the data relating to the control dogs enrolled in the study. 'Attributable risk', 'number needed to treat' and 'population attributable risk fraction' were calculated where appropriate.

The analysis assessing risk factors initially involved univariable screening. This was done using chi-squared tests of association and univariable logistic regression. The 'xtlogit' command (with country and urban/rural as fixed effects and veterinary practice identity as a random effect) was used in order to account for the clustering in the dataset. All variables were assessed for collinearity using a correlation matrix, and where two variables were found to be highly collinear a decision was made to exclude one variable from the model based on considerations including a priori importance of the risk factors, strength of associations and missing values (Dohoo and others 2003). All continuous variables were assessed graphically for normality. All variables that had a $P<0.2$ on univariable screening were put forward for mulitvariable analysis. Manual forward and backward stepwise multivariable mixed-effects logistic regression models were developed assessing the addition or removal of individual variables using the likelihood ratio test. Statistical significance was set at the 5 per cent level. If the likelihood ratio test was not significant, it was also checked whether the variable had a confounding effect by assessing changes in the coefficients and significance of other variables in the model before being removed. All final model variables were assessed for interactions. The fit of the model was assessed using Hosmer-Lemeshow goodness-of-fit test on the basic logistic regression model. As the 'xt' commands in Stata version 9 do not support goodness-of-fit tests, further diagnostics, including the calculation of leverage and delta-betas, were used to identify any outliers or highly influential observations. The 'quadchk' command was used on the final 'xtlogit' model to assess the sensitivity of the quadrature approximation. The change in coefficients was less than 0.01 per cent and therefore it can be assumed that the choice of quadrature did not significantly affect the results. Due to the a priori interest in working dogs, the variable 'work' was forced into all models to assess its significance. Several multivariable models were developed in order to assess various aspects of the data. A model was developed for all dogs in the study using different breed classifications, for spaniels only and for working dogs only.

The breed, sex and age of the dogs owned by non-responders among the cases and controls were compared with those that did respond in order to assess the representativeness of cases and controls. Additionally, the types of injuries recorded among the non-responding cases were compared to those of the cases whose owners did respond.

Results

A total of 314 veterinary practices were contacted initially. Of these practices, 198 either refused to participate or did not have a suitable computer system to be eligible for inclusion in the study. The remaining 116 practices were then sent a letter requesting their participation in the study, and 52 agreed to participate. The practices that did not

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agree to participate stated one of the following reasons: they did not want to participate in a study looking at such a topical issue, they did not have the time, or they were uncomfortable contacting their clients with questionnaires. The 52 participating veterinary practices provided clinical records for 138,212 dogs that had attended the practices within the previous 12-month period. A total of 281 cases were identified among these clinical records, but questionnaires could not be sent to all cases at the request of some practices. Three practices withdrew from participating in the study after their database had been queried, meaning that data were available on the number of cases and number of dogs attending the practice but the owners of these cases could not be sent questionnaires. Additionally, there were some cases that had recently died or been euthanased; the veterinary practice requested that a questionnaire not be sent to the owners of these dogs. A total of 224 questionnaires were sent out to owners of cases and 799 to owners of controls. Of all the cases, 97 owners responded (response rate 43.3 per cent), and 227 of the owners of controls responded (response rate 28.4 per cent). Five controls were excluded because these dogs had sustained a tail injury in the previous 12-month period but had not been seen or treated by a veterinarian. Among these five controls, two working dogs had sustained an injury while working and the other three dogs had sustained a household injury. One of these dogs had a docked tail before sustaining an injury. The proportion of male dogs among the controls was 48 per cent and among the cases it was 53 per cent. The mean (sd) age of the controls was 6.3 (4.2) years and of the cases it was 5.7 (3.8) years.

There was no significant difference between the proportions of specific breeds among the cases that responded and the cases that did not respond (P=0.351). Additionally, there was no significant difference in age (P=0.985) or sex (P=0.686) between the case responders and non-responders. Similar results were found when comparing the responders and non-responders among the controls (breeds P=0.974; age P=0.974; sex P=0.561). There was no significant difference in the type of tail injuries recorded in the clinical data between the case responders and case non-responders (P=0.873).

Tables 2 and 3 show some descriptive results of the number of dogs that were docked, the number used for work and the number of dogs of specific breeds among the cases and controls enrolled in the study. Among the 29 working dogs, all were used for game shooting except for five dogs: one of these was a racing greyhound, one was a German shepherd police dog and three were herding collies.

Risk of tail injury

The weighted risk of tail injuries seen by veterinarians across all regions was 0.23 per cent/year (95 per cent CI 0.20 to 0.25 per cent). The risks of tail injury in each country and location are given in Table 4.

Based on the proportion of working and non-working dogs among the cases and controls, the approximated risk among working dogs was 0.29 per cent (32 injuries among 10,974 dogs, 95 per cent CI 0.21 to 0.43 per cent) and the approximated risk among non-working dogs was 0.19 per cent (249 injuries among 127,238 dogs, 95 per cent CI 0.17 to 0.22 per cent); 29 was the number of working dogs among those that did respond, while 32 is the approximated number of working dog injuries expected had all the owners responded to the questionnaire, out of the total 10,974 clinical records. Working dogs had a statistically significantly higher risk than non-working dogs (P=0.032). The approximated risk for docked dogs was 0.03 per cent (six injuries among 21,285 dogs, 95 per cent CI 0.01 to 0.06 per cent) and for undocked dogs it was 0.23 per cent (275 injuries among 116,927 dogs, 95 per cent CI 0.21 to 0.27 per cent). Undocked dogs had a significantly higher risk than docked dogs (P<0.001). The attributable risk was calculated from these risk approximations and was found to be 0.20 per cent for docking, and therefore the 'number needed to treat' to prevent one tail injury was 500 dogs. The population attributable risk fraction for docking was a decrease of 11.9 per cent. Risk approximations were also calculated for breeds, and these results are given in Table 5.

Types of tail injury

Of the 97 cases for which a questionnaire was completed, 70.1 per cent (68 cases) were reported to be lacerations and bleeding, 20.6 per cent

TABLE 2: Number of dogs that were tail docked and that were used for work among the cases and controls in a study of the risk factors of tail injury

	Cases			Controls		
	Working	Not working	Total	Working	Not working	Total
Docked	0	2	2	9	26	35
Not docked	12	83	95	8	177	185
Total	12	85	97	17	203	220*

* Two owners did not state whether or not their dog's tail was docked

TABLE 3: Number of dogs of specific breeds/breed types, and whether they were or were not used for work, among the cases and controls

	Cases			Controls		
Breed/breed type	Working	Not working	Total	Working	Not working	Total
Labradors and other retrievers	3	16	19	4	34	38
English springer spaniels	4	13	17	7	9	16
Cocker spaniels	1	3	4	1	4	5
Border collies, rough collies	1	5	6	2	30	32
Jack Russell terriers	0	1	1	1	14	15
Lurchers, greyhounds, whippets	2	14	16	0	6	6
Other	1	33	34	2	108	110
Total	12	85	97	17	205	222

TABLE 4: Risk estimates for tail injury among dogs living in different countries within Great Britain and locations (rural or urban). No significant difference was found between any countries or locations

Category	Number of cases	Number of dogs at risk	Risk estimate (%)	95% CI
England			0.17	0.13-0.21
Urban	65	36,509	0.18	0.14-0.22
Rural	22	13,442	0.16	0.09-0.23
Scotland			0.22	0.18-0.26
Urban	48	25,816	0.19	0.14-0.24
Rural	72	29,679	0.24	0.18-0.30
Wales			0.23	0.18-0.28
Urban	72	31,646	0.23	0.18-0.28
Rural	2	1120	0.18	0.00-0.43
Weighted risk for Great Britain	281	138,212	0.23	0.20-0.25

CI Confidence interval

TABLE 5: Risk approximations for tail injuries in dogs of different breeds/breed types

Breed/breed type	Number of cases	Approximate number of dogs at risk	Risk estimate (%)	95% CI
Labradors and other retrievers	56	23,911	0.23	0.18-0.30
English springer spaniels	47	10,366	0.45	0.34-0.60
Cocker spaniels	12	3179	0.37	0.22=0.66
Border collies, rough collies	18	20,732	0.08	0.06-0.14
Jack Russell terriers	3	9675	0.03	0.01-0.09
Lurchers, greyhounds, whippets	47	3870	1.22	0.90-1.61
Other	98	66,479	0.15	0.12-0.18

CI Confidence interval

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TABLE 6: Results of a multivariable mixed-effects logistic regression model of risk factors associated with tail injuries in dogs in Great Britain (the number of observations used in the final model was 309 out of 319)

Variable category	Number of cases	Number of controls	β (se)	Odds ratio	95% CI	P
Breed						
Labradors and other retrievers	19	37		1.00		
English springer spaniels	16	16	1.786 (0.655)	5.97	1.65-21.52	0.006
Cocker spaniels	4	5	1.558 (0.989)	4.75	0.68-33.03	0.115
Border collies/rough collies	6	32	−0.753 (0.546)	0.47	0.16-1.37	0.168
Jack Russell terriers	1	15	−1.492 (1.096)	0.22	0.03-1.93	0.173
Greyhounds, lurchers, whippets	16	6	1.924 (0.604)	6.85	2.10-22.39	0.001
Other breeds	33	103	−0.152 (0.365)	0.86	0.42-1.76	0.677
Missing	2	8				
Tail docked before injury						
No	93	181		1.00		
Yes	2	33	−3.467 (0.913)	0.03	0.01-0.19	<0.001
Tail wag angle						
Narrow	10	61		1.00		
Moderately wide	28	62	1.066 (0.464)	2.91	1.17-7.21	0.021
Very wide	57	91	1.315 (0.433)	3.72	1.59-8.70	0.002
Dog kept in kennels (during night, day or both)						
No	78	201		1		
Yes	17	13	1.281 (0.508)	3.60	1.33-9.75	0.012
Work use*						
No	84	197		1		
Yes	11	17	−0.339 (0.656)	0.71	0.20-2.58	0.605
Intercept	–	–	−1.906 (0.493)	–	–	–
Random effect of practice identity (ρ)	–	–	0.009 (0.013)	–	–	0.350

* Forced into model due to a priori interest in working dogs
CI Confidence interval

(20 cases) fractures or dislocations, and of the rest (9.3 per cent, nine cases) six cases were self-trauma and three cases were neoplasia. The questionnaires reported that 44.3 per cent (43 cases) were recurrent tail injuries (based on the owners' assessments) and 53.6 per cent (52 cases) were not recurrent; in two cases it was not stated whether the injury was recurrent. According to the owners' assessments, 36.1 per cent (35 cases) of the injuries were caused by the dog knocking its tail against a wall, kennel wall or another household object, 17.5 per cent (17 cases) were injuries from undergrowth or fences during exercise or work, 14.4 per cent (14 cases) were due to the tail being caught in a door, 15.5 per cent (15 cases) were due to other various causes, and in 16.5 per cent (16 cases) the cause was unknown. The majority of injuries (57.7 per cent, 56 cases) were treated conservatively with antibiotics, anti-inflammatories and dressings, 30.9 per cent (30 cases) resulted in amputation of the tail, and 11.4 per cent (11 cases) did not require any specific treatment.

Risk factors for tail injuries

The major risk factors for tail injuries identified in the final multivariable model are shown in Table 6. Breed was an important factor: English springer spaniels had 5.97 times the odds of sustaining an injury compared with labradors and other retrievers, and greyhounds, lurchers and whippets had 6.85 times the odds. Dogs with docked tails had 0.03 times the odds of an injury compared with the dogs that were undocked. Dogs kept in kennels during the day, at night or both had 3.60 times the odds of sustaining a tail injury compared with those that were not kept in a kennel. Also, dogs that wagged their tails in a very wide angle had 3.72 times the odds, and those that wagged their tail in a moderately wide angle had 2.91 times the odds, of sustaining an injury compared with the dogs that wagged their tails in only a narrow angle.

Other factors (the height and weight of the dog, body length, coat type and type of tail hair) were also shown to be significant factors (results not shown). However, these factors were not included in the final model as there was strong collinearity with the variable breed, which increased the standard errors of the estimates for breed and made the model unstable.

The variable 'work' was forced into the model due to the a priori interest in work as a risk factor, despite this variable not being significant. A variable classifying dogs into 'game shooting', 'other type of work' or 'no work' was also assessed and found to be not significant.

There were no interactions found and the fit of the model was good (Hosmer-Lemeshow model fit statistic P=0.733). The area under the receiver operating characteristic (ROC) curve for the logistic regression model was 0.7854 and there were no particularly high leverage or delta-beta values (defined as delta-beta >1.0, leverage >2 k/n, where k is the number variables and n is the number of observations) (Hosmer and Lemeshow 2000), which indicated no highly influential observations and supported good model fit.

Due to the high level of collinearity of many variables with breed and the increased odds in spaniels, the model was repeated restricting the analysis to only spaniels (cocker and English springer spaniels). The results of this model are shown in Table 7. This shows that whether a dog's tail was docked or not was the most important factor, with docked dogs having 0.008 times the odds of sustaining a tail injury compared to dogs with undocked tails. The dog's sex was included in the model as it had a confounding effect on docking. 'Work' was forced into the model but was found to be non-significant. The fit of the model was good and the area under the ROC curve was 0.930. The model development was repeated using the different classifications of breeds according to the current English and Welsh legislation for tail docking (results not shown). The results of these models showed similar results to the model shown in Table 6. A model was also developed restricting the analysis to just working dogs. In this case, docked dogs were at significantly lower risk of sustaining a tail injury compared with those with undocked tails, and dogs kept in kennels were at a significantly higher risk (results not shown).

Discussion

This study has been able to estimate the risk of tail injuries in Great Britain and identify major factors associated with a tail injury occurring in a large population of dogs attending a veterinary practice. The overall risk of injury was low, and trauma not associated with work accounted for the majority of injuries seen by participating veterinary practices. Work in itself was not a major risk factor, and characteristics such as the dogs' breed, tail wag angle and docking status were more important factors associated with tail injury in practice-attending dogs.

The overall weighted risk of tail injuries in dogs in Great Britain was estimated to be 0.23 per cent per year, which was lower than the prevalence (0.39 per cent) found by Darke and others (1985). This suggests that tail injuries requiring treatment in the general dog population of Great Britain could be rarer than previously thought. The difference in results between the studies may be due to differences in the population studied. In the study by Darke and others (1985), the study population was predominantly urban, and restricted to dogs attending the University of Edinburgh's small animal clinic. In the present study, the dogs sampled were selected from veterinary practices throughout Great Britain, in both urban and rural areas, and therefore were more likely to be representative of the general dog population of Great Britain. The study in Edinburgh included dogs with tail lacerations, contusions, fractures, dislocations, self-trauma, neoplasia and dermatoses among the cases. However, the present study included only dogs with lacerations, contusions, fractures, dislocations, self-trauma and neoplasia as cases. Dogs with tail dermatoses were not considered as cases for the present study as there are many potential causes of this condition, such as allergies, flea infestation or even impacted anal glands. In addition, the risk estimate in the present study is based on a population of 138,212 dogs, whereas the study by Darke and others (1985) based the risk estimate on a population of 12,129 dogs.

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TABLE 7: Results of multivariable mixed-effects logistic regression model of risk factors associated with tail injuries in spaniels in Great Britain (the number of observation used in the final model was 41)

Variable category	Number of cases	Number of controls	β (se)	Odds ratio	95% CI	P
Tail docked before injury						
No	19	4		1		
Yes	1	17	−4.885 (1.390)	0.008	0.0004-0.12	<0.001
Sex						
Male	14	8		1		
Female	6	13	−2.108 (1.214)	0.121	0.01-1.31	0.082
Work use*						
No	15	13		1		
Yes	5	8	−0.068 (1.144)	0.934	0.10-8.81	0.953
Intercept	–	–	2.758 (1.073)	–	–	–
Random effect of practice identity (ρ)	–	–	0.012 (0.030)	–	–	0.426

* Forced into model due to a priori interest in working dogs
CI Confidence interval

The risk of tail injuries found in the present study indicates that tail injuries are very rare, and the approximated risk of tail injuries in working dogs was only slightly higher at 0.29 per cent. In the study by Houlton (2008), 21 of 668 (3.14 per cent) working dogs studied sustained injuries including articular pathology, fractures and muscular injuries, among which tail injuries were included. However, direct comparison of these risks cannot be made due to the differences in the populations of dogs studied: the study by Houlton (2008) focused only on working dogs but the present study included all practice-attending dogs, of which working dogs represented only a small proportion (9.1 per cent). In addition, the risk estimated by Houlton (2008) related to many different types of injury, not just tail injury.

The present study found no significant difference in risk between England, Scotland and Wales, or between urban and rural areas. This could indicate that there are no differences at all and the rate of tail injury is so low that minor policy differences between the countries have no practical consequences, or that these differences have yet to have a significant impact on the likelihood of tail injuries. This study was started approximately one year after the introduction of the new legislation, and therefore it may be too soon to detect differences in the risks of tail injury due to the differences in legislation. Dogs born after the ban on tail docking would have been at most 18 to 24 months of age at the time of the study. Additionally, the current legislation does not prevent docked or undocked dogs from being moved between countries.

The most common type of tail injury reported in the present study was lacerations and bleeding. This is similar to the findings of Houlton (2008), where tail tip injuries were the most frequently reported tail injury. It was also interesting to note that 44.3 per cent of the tail injuries were reported to be recurrent injuries. This shows an agreement with anecdotal evidence that suggests that tail injuries are very difficult to treat, often resulting in many treatment attempts before finally having to amputate the tail. In the present study, almost one-third of tail injuries requiring veterinary treatment resulted in amputation.

The risk factor analysis identified several important risk factors. English springer spaniels and cocker spaniels were both at much higher risk compared with labradors and other retrievers. This finding supports that of Houlton (2008), who found that tail injuries were much more common among these breeds than labradors or pointers. Additionally, it was found that greyhounds, lurchers and whippets were at a significantly higher risk than labradors, and also higher than English springer and cocker spaniels. It has been anecdotally reported that the high risk among greyhounds, lurchers and whippets may be due to their long, whip-like tails, which have very little hair cover for protection (Anon 2008). However, it is important to keep in mind that, despite these breeds being shown to be the highest risk groups, the overall risk of tail injuries was still low.

Factors such as height, weight, body length, coat type and tail hair were found to be significant factors on univariable analysis. However, these factors could not be included in the final model because they were highly collinear with breed.

In the final model, tail wag angle was found to be a risk factor, with dogs that reportedly wagged their tails over a very wide angle being at greater risk. This intuitively makes sense, as the wider a dog wags its tail, the more likely it is to knock the tail against objects in its surroundings compared with dogs that wag their tails in a narrow angle; in addition, the force with which dogs wag their tails may be greater over a wide angle. A dog being kept in kennels was found to be an important risk factor for a tail injury. This could possibly be due to the size of the kennels being too small in relation to the size of the dogs, thereby increasing the chances of the dog knocking its tail against the kennel wall. It could also be closely linked to working dogs (58.6 per cent of working dogs lived in kennels, while only 5.2 per cent of non-working dogs lived in kennels). However, the variable 'work' was found to be non-significant regardless of whether the kennel variable was included in the model. This suggests that work itself was not a major risk factor after adjusting for other major factors. 'Work' was highly collinear with breed, and it could be argued that breed was masking the effect of work. However, in the model examining only spaniels, work was still non-significant. The present study had only low power to evaluate work as a risk factor based on the prestudy power calculations (8 per cent of the control population were working dogs), and further work on working dogs may be merited.

The present study suggests that dogs that are docked are less likely to sustain a tail injury. This supports the findings of the study conducted by Houlton (2008), which showed that there was a strong association between tail injuries and undocked English springer and cocker spaniels. In contrast, Darke and others (1985) found no significant association. The difference in findings from the latter study may have been related to that study assessing the customary/traditional docking status of breeds and not the actual docking status of individual dogs, the predominately urban clientele, the lack of adjustment for confounding factors, and the small sample size. In the present study, the results of the additional models for spaniels only and for working dogs only also showed tail docking to be an important factor in reducing the likelihood of a dog sustaining a tail injury. This is to be expected, as if a dog does not have a tail, it has no tail to injure, or if it has a tail of reduced length, it is less likely to injure the shorter tail. The important factor to examine is the level of protection that docking provides and how much more likely an undocked dog is to sustain a tail injury. The population attributable risk fraction estimate indicates, assuming a causal association, that tail docking in the dog population studied is responsible for a 12 per cent reduction in tail injuries, which could be considered to be a large and notable decrease. However, in absolute terms, the attributable risk was small at 0.20 per cent, and the number of dogs that would need to be treated (docked) in order to prevent one tail injury was very large, at 500 dogs. Additionally, when considering these results, due to the low number of docked dogs among the cases, extrapolation of the results to the general dog population in Great Britain should be interpreted cautiously. One of the factors of interest at the start of the study was the length of the dog's tail, and not just whether or not it had been docked. Some breeds of dog have their tails docked to two-thirds the normal length (for example, Weimaraner, Hungarian vizsla), others to half the length (for example, miniature poodle), and other breeds have most of the tail removed (for example, rottweiler, Welsh corgi). Unfortunately, due to the small number of docked dogs among the cases, it was not possible to categorise dogs into different docking lengths in this study.

Tail docking remains a controversial issue, as evidenced by recent correspondence (Davidson 2006, King 2007, Penny 2007) and the number of submissions received by Parliament in the drafting of the Animal Welfare Bill (Defra 2002). The debate is centred on whether 7 non-therapeutic tail docking reduces the risk of tail injuries sufficiently to justify the ethical concerns regarding this prophylactic intervention (Bower and Anderson 1992, Morton 1992, Bennett and Perini 2003). A study conducted in Sweden reported that, after a tail docking ban was put in place, the incidence of tail injuries in German shorthaired pointers had increased (Strejffert 1992). However, that study also had several weaknesses: it followed a limited number of litters (53), did not make comparisons between docked and undocked dogs, did not compare animals before and after the ban, and did not make any statistical comparisons to support the conclusions. Therefore, conclusions based on the study should be examined cautiously.

It is important to be aware of the limitations of the present study. Due to the random sampling and selection of veterinary practices, only a small number of working dogs were included in the study. This could potentially decrease the chance of finding any significant association between work and tail injuries. Additionally, many of the variables in this dataset were highly collinear, forcing decisions to be made as to which variables to include and which to exclude from the final model. This, too, may have resulted in the presence of residual confounding, thereby weakening any associations or potentially masking others. One of the potential biases could be the representativeness of the sample selected. The numbers of veterinary practices selected in each region were not sampled by probability proportional to size. This is because there is a very high proportion of practices in England, such that if this approach had been used, almost no practices would have been selected in Wales and Scotland, making it impossible to estimate the risk of tail injuries in these regions with any confidence. Additionally, only practices using specific software packages were included in the study, and it could be argued that this makes the sample unrepresentative of the general population of dogs in Great Britain. However, the cooperation of the some of the biggest software companies was obtained and seven different practice management systems were included. As mentioned previously, the sample may be unrepresentative because not all injuries would have been seen by a veterinarian. This bias was also highlighted by Houlton (2008). Some dogs that had sustained a tail injury may not have been examined by a veterinarian. It is likely that the present study was biased towards evaluation of major injuries, as more minor injuries may be less likely to be examined and/or treated by a veterinarian. Five control dogs had to be excluded because they had sustained a tail injury in the previous 12-month period but not been seen by a veterinarian. This may indicate that the prevalence of all tail injuries could be higher than estimated in this study; however, these injuries were likely to be less severe, as they had not been seen by a veterinarian, and therefore less likely to raise welfare concerns. Additionally, the number of untreated injuries among the controls was based on a relatively small sample (5 of 227 controls, 2.20 per cent) and the likely range in the true value would be great (95 per cent CI 0.94 to 5.35 per cent).

The response rate of practices was low, and the average response rate of dog owners (cases and controls) was 35 per cent. This may be due to the controversial nature of tail docking, with some people unwilling to participate. Comparison of a number of key characteristics available suggested that responders were representative of the target population.

This study is the largest study to date and the first study to assess the risk of tail injury and risk factors for dogs from all parts of Great Britain allowing objective assessment of the frequency of injuries and risk factors associated with them. The present study has suggested that the overall risk of tail injuries is low, although specific breeds including spaniels, greyhounds and lurchers were at substantially higher odds of injury. The final multivariable risk factor model showed that being a working dog was not a major risk factor for tail injury, and other factors, including breed characteristics and levels of activity of dogs, were more important than work itself in the practice-attending population. Docking appeared to have a protective effect against injury, as expected; however, it was calculated that 500 dogs would need to be docked in order to prevent one tail injury. Further studies focusing on what appear to be the highest-risk groups of dogs would be valuable.

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References

ANON (2006) Animal Welfare Act 2006. Chapter 45. Stationery Office. Accessed May 12, 2010

ANON (2008) Why the tail-docking of dogs should be prohibited. www.onekind.org/info-hub/reports/108-tail-docking. Accessed June 3, 2010

BENNETT, P. C. & PERINI, E. (2003) Tail docking in dogs: a review of the issues. *Australian Veterinary Journal* **81**, 208-218

BOWER, J. & ANDERSON, H. P. (1992) Confronting cosmetic surgery: cropping and docking not clear-cut issues. *Journal of the American Veterinary Medical Association* **200**, 1595-1597

DARKE, P. G., THRUSFIELD, M. V. & AITKEN, C. G. (1985) Association between tail injuries and docking in dogs. *Veterinary Record* **116**, 409

DAVIDSON, D. (2006) Non-therapeutic docking of dogs' tails. *Veterinary Record* **158**, 70

DEFRA (2007) Regulatory Impact Assessment: Draft of the Docking of Working Dogs' Tails (England) Regulations 2007. www.opsi.gov.uk/si/si2007/em/uksiem_20071120_en.pdf. Accessed March 26, 2009

DEFRA (2002) The consultation on an Animal Welfare Bill: an analysis of the replies. www.defra.gov.uk/wildlife-pets/pets/cruelty/documents/awbillconsultanalysis.pdf. Accessed March 26, 2009

DOHOO, I., STRYHN, H. & MARTIN, S. W. (2003) Model building strategies. In Veterinary Epidemiologic Research. University of Prince Edward Island. pp 317-334

HOSMER, D. W. & LEMESHOW, S. (2000) Assessing the fit of the model. In Applied Logistic Regression. John Wiley & Sons. pp 167-187

HOULTON, J. E. (2008) A survey of gundog lameness and injuries in Great Britain in the shooting seasons 2005/2006 and 2006/2007. *Veterinary and Comparative Orthopaedics and Traumatology* **21**, 231-237

KING, R. (2007) Docking of dogs' tails. *Veterinary Record* **160**, 99

MORTON, D. (1992) Docking of dogs: practical and ethical aspects. *Veterinary Record* **131**, 301-306

OFFICE FOR NATIONAL STATISTICS (2006) Postcode Directories. Census Geography Data Unit/EDINA

ORLANS, F. B., BEAUCHAMP, T. L., DRESSER, R., MORTON, D. B. & GLUCK, J. P. (1998) Should the tail wag the dog? In The Human Use of Animals: Case Studies in Ethical Choice. Oxford University Press. pp 273-287

PENNY, R. H. C. (2007) Docking of dogs' tails. *Veterinary Record* **160**, 99-100

RCVS (2008) Directory of Veterinary Practices 2008. RCVS

STREJFFERT, G. (1992) Tail injuries of Shorthaired German Pointer dogs born in Sweden 1989. www.cdb.org/countries/sweden.htm. Accessed March 25, 2009