THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Smooth Fox Terrier

Evidence Base

CONTENTS

INTRODUCTION

The Kennel Club launched a new resource for breed clubs and individual breeders – the Breed Health and Conservation Plans (BHCP) project – in September 2016. The purpose of the project is to ensure that all health concerns for a breed are identified through evidence-based criteria, and that breeders are provided with useful information and resources to raise awareness of current health and welfare concerns in their breed, and support them in making balanced breeding decisions.

The Breed Health and Conservation Plans take a complete view of breed health with consideration to the following issues: known inherited conditions, complex conditions (i.e. those involving many genes and environmental effects such as nutrition or exercise levels, for example hip dysplasia), conformational concerns and population genetics.

Sources of evidence and data have been collated into an evidence base which gives clear indications of the most significant health conditions in each breed, in terms of prevalence and impact. Once the evidence base document has been produced it is discussed with the relevant Breed Health Co-ordinator and breed health representatives where applicable. Priorities are agreed based on this data and incorporated into a list of actions between the Kennel Club and the breed to tackle these health concerns. These actions are then monitored and reviewed on a regular basis.

DEMOGRAPHICS

The number of Smooth Fox Terriers registered by year of birth between 1990 and 2020 are shown in Figure 1. The Smooth Fox Terrier is a vulnerable native breed, with fewer than 300 dogs registered per year. The trend of registrations over year of birth (1990-2020) was -4.55 per year (with a 95% confidence interval of -5.68 to -3.42) reflecting the gradual decrease in registrations over this period. As of 2020 fewer than 150 dogs of the breed were registered.

[Put simply, 95% confidence intervals (C.I.s) indicate that we are 95% confident that the true estimate of a parameter lies between the lower and upper number stated.]

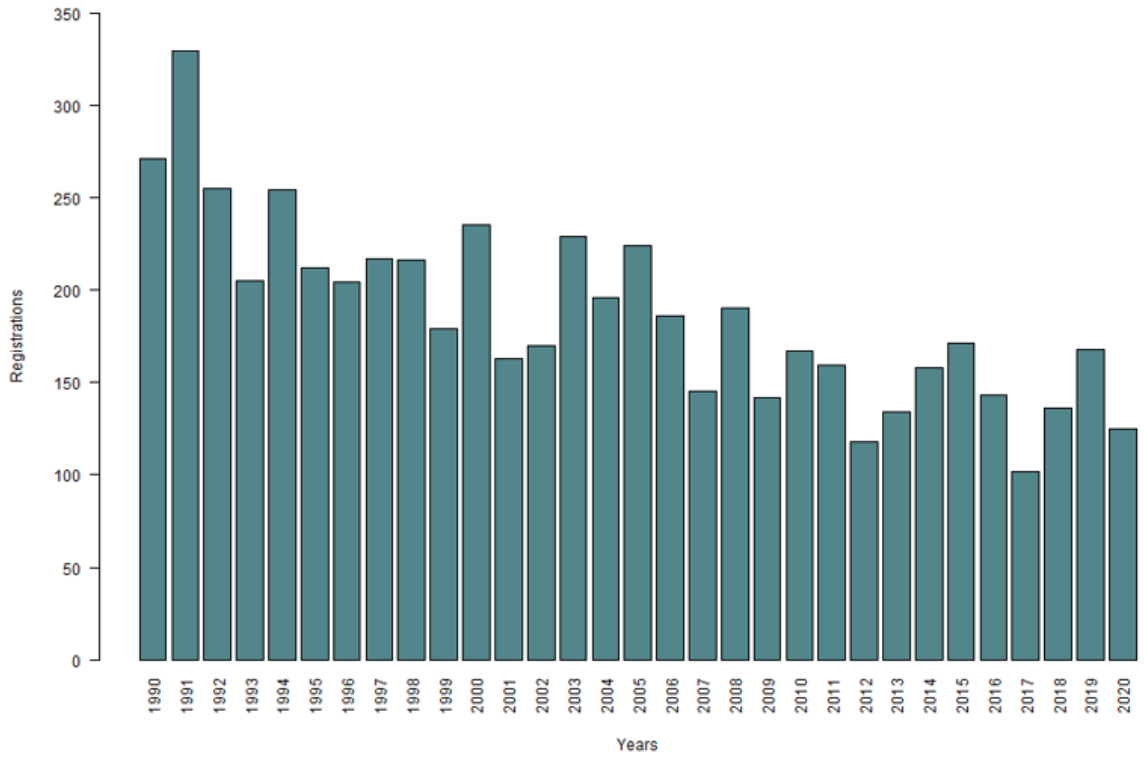


Figure 1: Number of registrations of Smooth Fox Terriers per year of birth, 1990 – 2020.

BREED HEALTH CO-ORDINATOR ANNUAL HEALTH REPORT

Breed Health Co-ordinators (BHCs) are volunteers nominated by their breed to act as a vital conduit between the Kennel Club and the breed clubs with all matters relating to health.

No health concerns were listed for the breed in either the 2018 or 2019 Annual Health Report. However, in terms of what the breed has done to help tackle any unidentified health and welfare concerns, the breed developed a breed specific health survey.

BREED CLUB HEALTH ACTIVITES

The Smooth Fox Terrier has an active Breed Health Coordinator (BHC).

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Purebred and Pedigree Dog Health Surveys Results

The Kennel Club Purebred and Pedigree Dog Health Surveys were launched in 2004 and 2014 respectively for all of the recognised breeds at the time, to establish common breed-specific and breed-wide conditions. It is worth noting that the Smooth and Wire Fox Terriers were combined for the 2004 survey and so caution should be taken when interpreting the results; the 2014 however is specific to the Smooth Fox Terrier.

2004 Morbidity results: Health information was collected for 115 live Fox Terrier of which 77 (67%) were healthy and 38 (33%) had at least one reported health condition. The top categories of diagnosis were dermatologic (13.2%, 7 of 53 reported conditions), musculoskeletal (11.3%, 6 of 53 conditions), neurologic (11.3%, 6 of 53 conditions), urologic (11.3%, 6 of 53 conditions), and gastrointestinal (9.4%, 5 of 53 conditions). The most frequently reported specific conditions were undiagnosed skin irritation/ scratching/ itchy skin (9.4%, 5 of 53), seizures/ fits/ epilepsy idiopathic (7.5%, 4 of 53), allergy unspecified (5.7%, 3 of 53), bladder infection/ cystitis (5.7%, 3 of 53), and stuck puppy/ physical blockage (5.7%, 3 of 53).

2004 Mortality results: A total of 44 deaths were reported for the Fox Terrier. The median age at death was 13 years and 2 months (min = 10 months, max = 17 years and 3 months). The most frequently reported causes of death by organ system or category were old age (31.8%, 14 of 44), cancer (22.7%, 10 of 44), trauma (11.4%, 5 of 44), cardiac (6.8%, 3 of 44), and urologic (6.8%, 3 of 44).

2014 Morbidity results: Health information was collected for 38 live Smooth Fox Terrier of which 32 (84.2%) had no reported conditions and 6 (15.8%) were reported to be affected by at least one condition. The reported conditions were cataract (age related), overactive sex hormones, pancreatitis, skin (cutaneous) cyst, skin cancer/ tumour and skin lump. Each of these conditions were reported just once.

2014 Mortality results: A total of seven deaths were reported for the breed. The range of age at death for the Smooth Fox Terrier was five years to 18 years. The reported causes of death by organ system or category were old age (three cases, proportion 42.9%), and then one death for each of the following: lymphoma, road traffic accident, senile dementia/ cognitive dysfunction, and stroke.

Please note caution should be taken when drawing meaningful conclusions from this data, given the small number of reports for the breed.

Smooth Fox Terrier Breed Health Survey 2018/19

A total of 99 individual responses were collected for the survey, representing 138 dogs in total.

When asked if the dog was Kennel Club registered, out of 138 dogs, 94.20% were registered and 5.80% were not. When asked the sex of the dog, out of 138 dogs, 56.52% were male and 43.48% were female. When asked the neutered status of the dog, out of 138 dogs, 41.30% were neutered and 58.70% were entire.

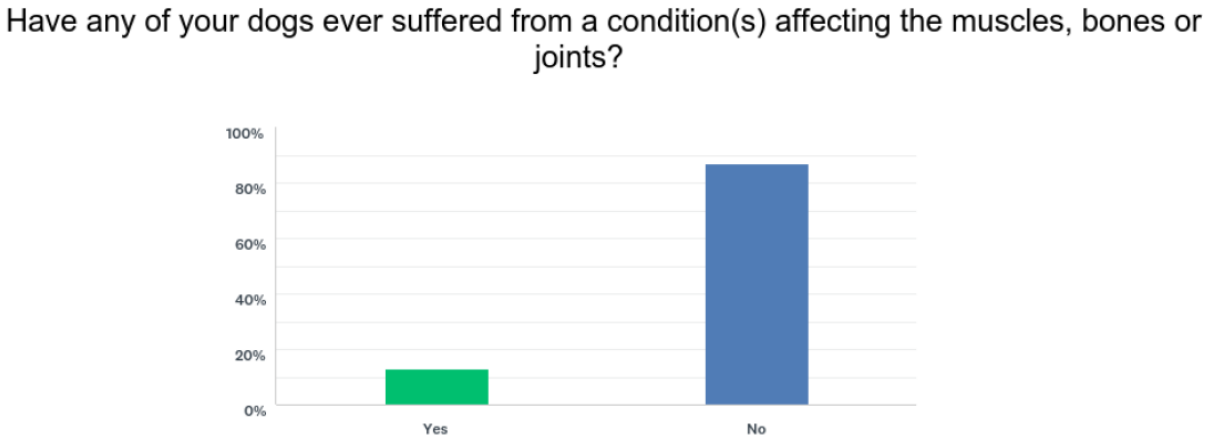
When asked if the dog had been bred from, 19.72% had at least one litter, and 80.28% had not.

The survey investigated the number of dogs affected by specific conditions within different categories: ‘Muscles, Bones and Joints’, ‘Ears, Skin and Coat’, ‘Gastrointestinal’, ‘Neoplasia’, ‘Ocular’, ‘Reproductive’, ‘Neurological’, ‘Respiratory’, ‘Renal’, ‘Hormonal’, ‘Cardiovascular’, ‘Immunological’ and ‘Other’.

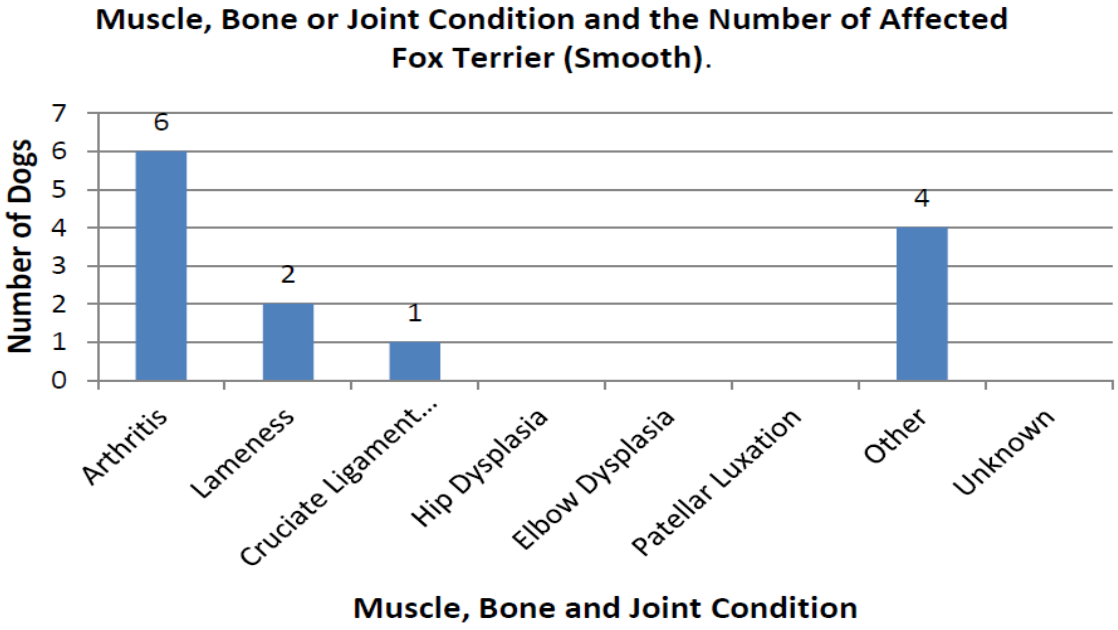
Within each of these categories, the respondents were given a choice of specific conditions, the choices of ‘unknown’ and ‘other’ were also given.

Muscles, Bones and Joints

When asked if any of their dogs have suffered from a muscle, bone or joint condition(s), out of the 99 responses, 13.13% said ‘yes’ and 86.87% said ‘no’.



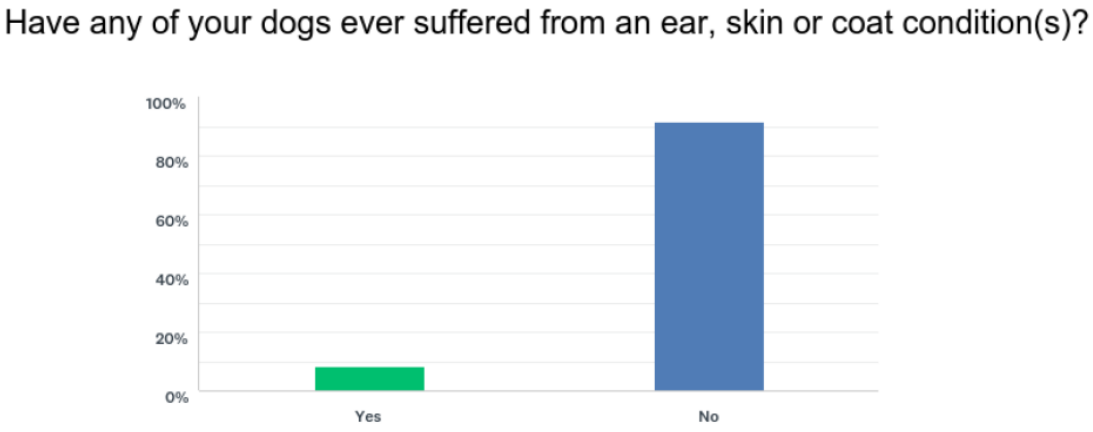
The choices of conditions given were: arthritis, lameness, cruciate ligament rupture, hip dysplasia, elbow dysplasia, patellar luxation, other and unknown.



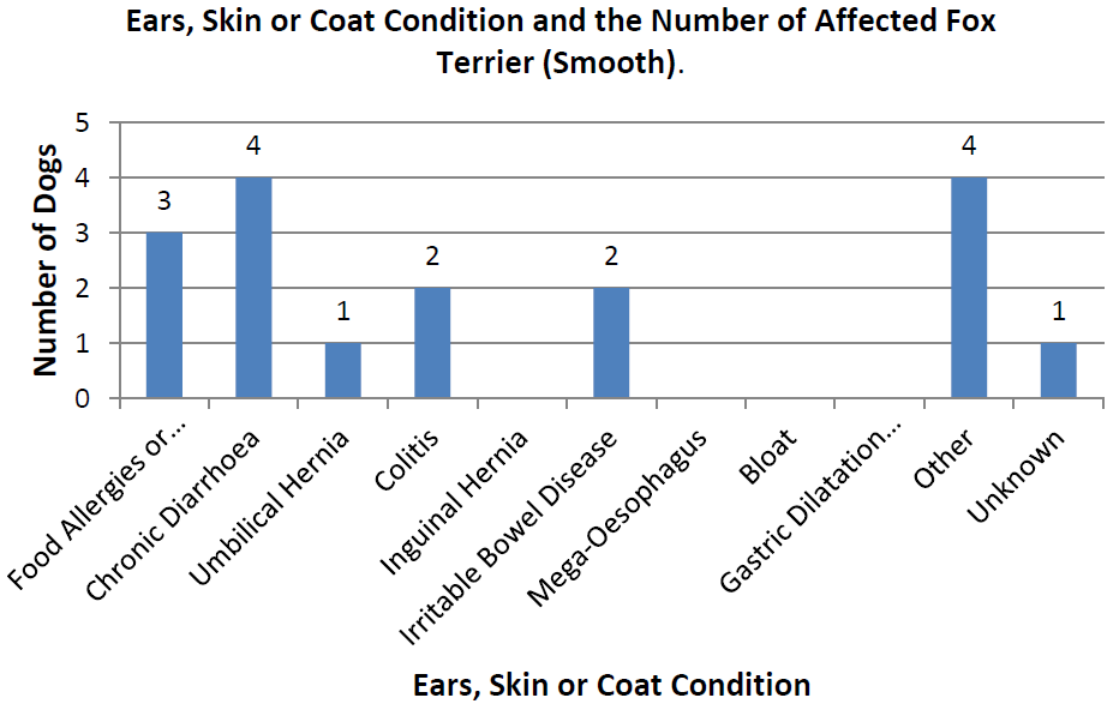
The most commonly reported muscle, bone or joint condition was arthritis which affected 4.35% of the study sample. This was followed by patellar luxation which was in 2.90% and lameness in 1.45%. When answering “other” respondents mentioned: patellar luxation (n=2), muscle tear (n=1) and paralysis (n=1).

Ears, Skin and Coat

When asked if any of their dogs have suffered from an ear, skin and coat condition(s), out of the 96 responses, 8.33% said ‘yes’ and 91.67% said ‘no’.



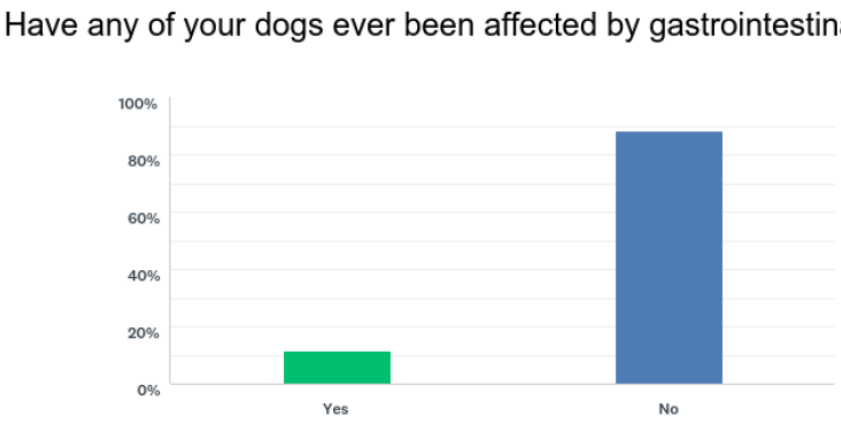
The choices of conditions given were: dermatitis, pyotraumatic dermatitis, calcinosis circumscripta, pyoderma, alopecia, inter-digital cysts, skin (sebaceous) cyst, ear mite infestation, excessive ear wax, other and unknown.



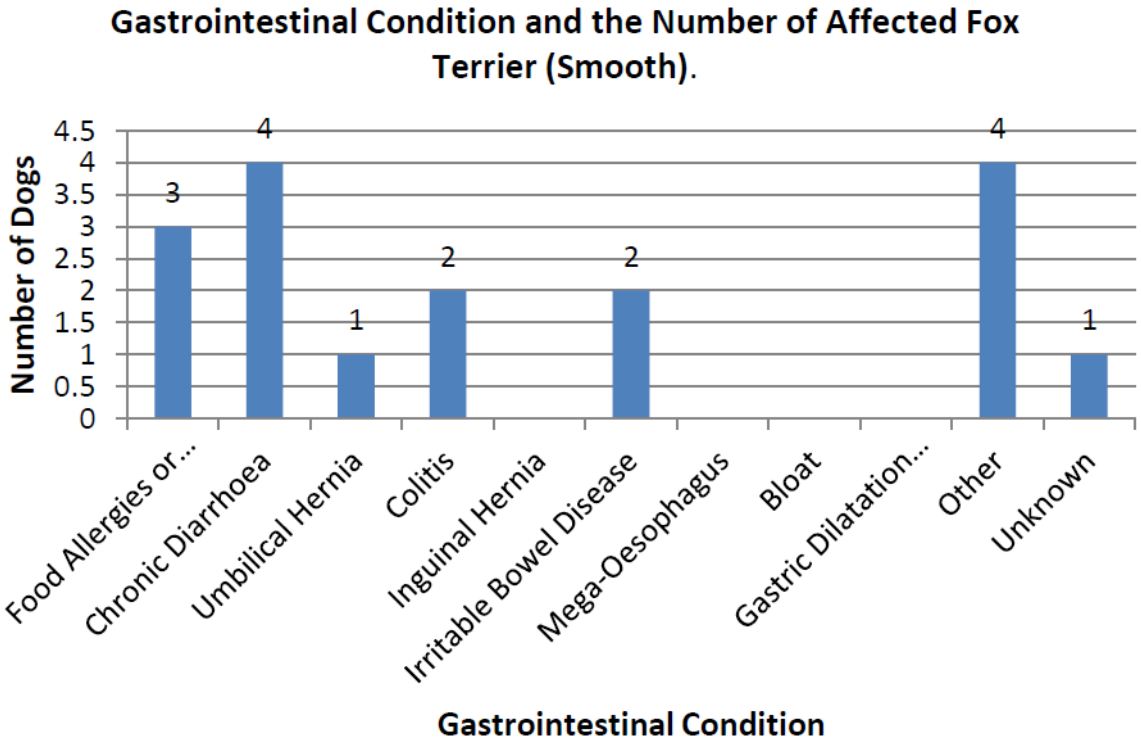
The most commonly reported ear, skin or coat condition was dermatitis and inter-digital cysts which affected 1.45% of the study sample. When answering “other” respondents mentioned: mange (n=1).

Gastrointestinal

When asked if any of their dogs have suffered from a gastrointestinal condition(s), out of the 96 responses, 11.46% said ‘yes’ and 88.54% said ‘no’.



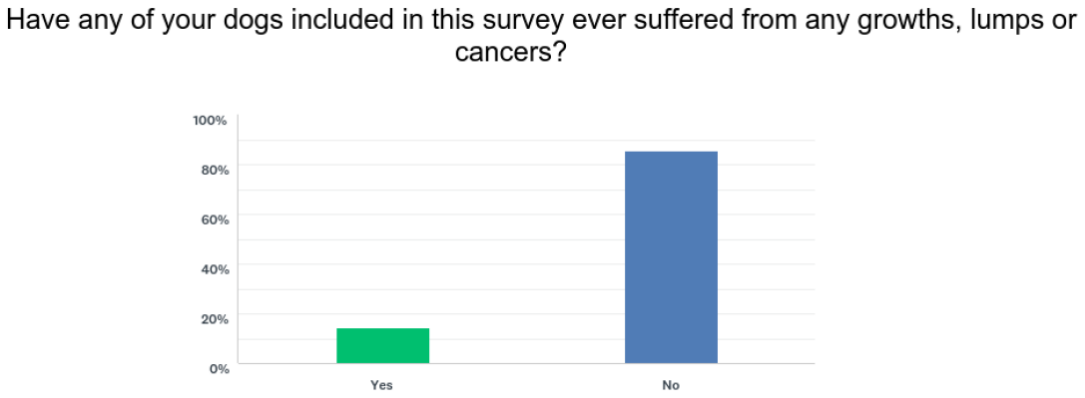
The choices of conditions given were: food allergies or intolerance, chronic diarrhoea, umbilical hernia, colitis, inguinal hernia, irritable bowel disease, mega-oesophagus, bloat, gastric dilatation, volvulus/ torsion, other and unknown.



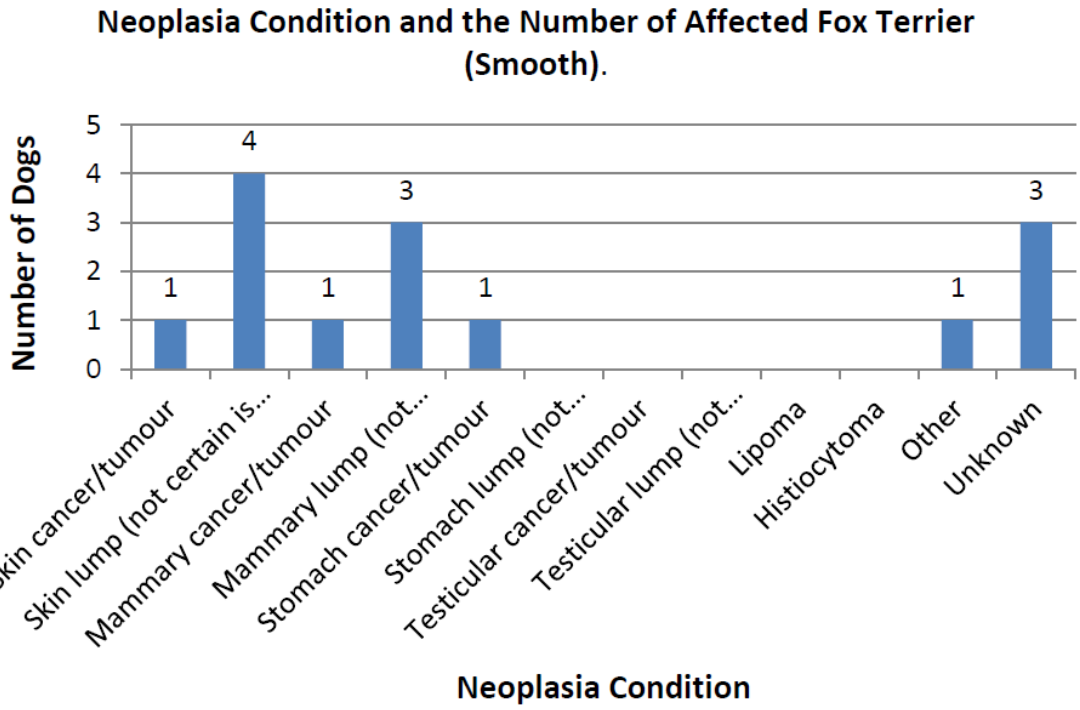
The most commonly reported gastrointestinal condition was chronic diarrhoea which affected 2.90% of the study sample. This was followed by food allergies or intolerance and vomiting which was in 2.17%. When answering “other” respondents mentioned: vomiting (n=3) and intestinal bleed (n=1).

Neoplasia/ cancer

When asked if any of their dogs have suffered from a neoplasia condition(s), out of the 96 responses, 14.58% said ‘yes’ and 85.42% said ‘no’.



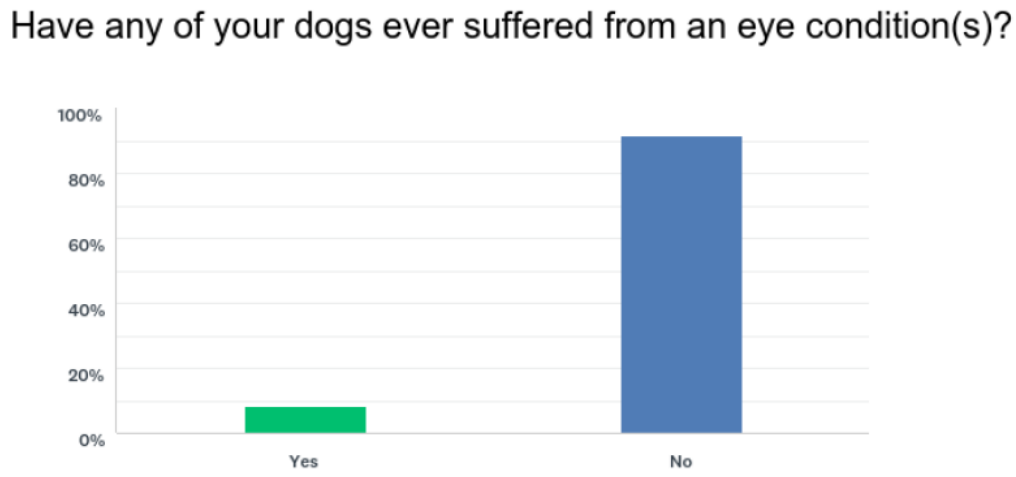
The choices of conditions given were: skin cancer/tumour, skin lump, mammary cancer/tumour, mammary lump, stomach cancer/tumour, stomach lump, testicular cancer/tumour, testicular lump, lipoma, histiocytoma, other and unknown.



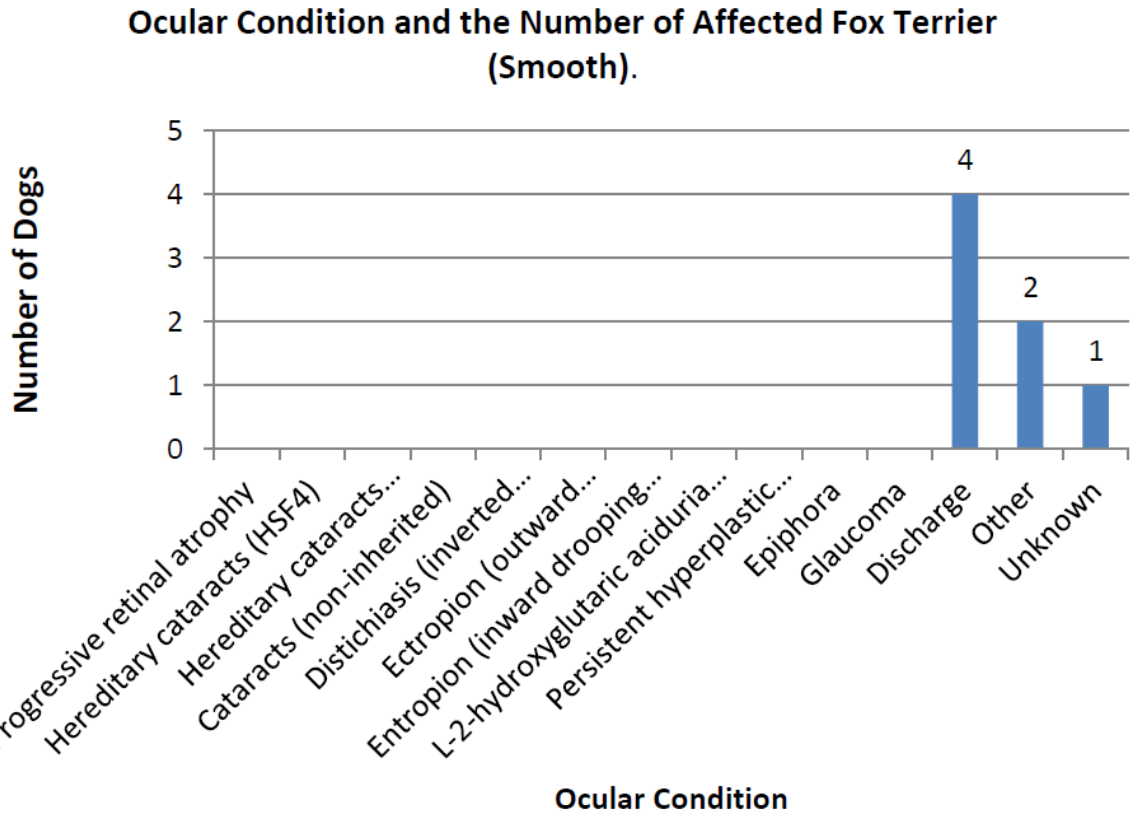
The most commonly reported neoplasia condition was a skin lump which affected 2.90% of the study sample. This was followed by mammary lump which was found in 2.17%. When answering “other” respondent mentioned: lung tumour (n=1).

Ocular

When asked if any of their dogs have suffered from an ocular condition(s), out of the 96 responses, 8.33% said ‘yes’ and 91.67% said ‘no’.



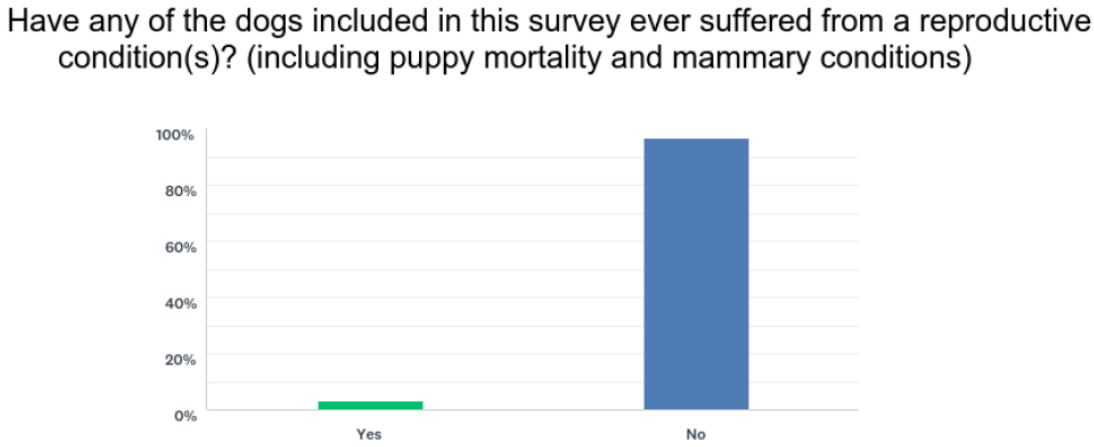
The choices of conditions given were: progressive retinal atrophy, hereditary cataracts (hsf4), hereditary cataracts (unknown), cataracts (non-inherited), distichiasis (inverted eyelashes), ectropion (outward drooping of eyelid), entropion (inward drooping of eyelid), l-2-hydroxyglutaric aciduria (l-2hga), persistent hyperplastic primary vitreous (phpv), epiphora, glaucoma, discharge, other and unknown.



The most commonly reported ocular condition was discharge which affected 2.90% of the study sample. This was followed by narrow tear duct which was found in 1.45%. When answering “other” respondents mentioned: narrow tear ducts (n=2)

Reproductive

When asked if any of their dogs have suffered from a reproductive condition(s), out of 95 responses, 3.16% said ‘yes’ and 96.84% said ‘no’.



The choices of conditions given were: dystocia, fading puppies, foetal death/natural abortion, foetal reabsorption, mastitis (breast inflammation/infection), pseudopregnancy (phantom pregnancy), pyometra (infection of the uterus), cryptorchidism, infertility, irregular heat cycles, prolapsed uterus, other and unknown.

One report was received for each of the following: fading puppies, foetal reabsorption, pseudopregnancy and prolapsed uterus.

Respiratory

When asked if any of their dogs have suffered from a respiratory condition(s), out of 95 responses, 3.49% said ‘yes’ and 96.51% said ‘no’.

The choices of conditions given were: kennel cough, chronic difficulty in breathing, rhinitis/ nose infection, other and unknown.

Two dogs were affected with an unknown disorder, and one kennel cough. When answering “other” respondents mentioned: respiratory tract infection (n=1) and pneumonia (n=1).

Cardiovascular

When asked if any of their dogs have suffered from a cardiovascular condition(s), out of 98 responses, 4.08% said ‘yes’ and 95.92% said ‘no’.

The most commonly reported cardiovascular condition was a murmur which affected 2.17% of the study sample. This was followed by pericardial effusion which was found in one dog. The conditions stated by the owners were murmurs (three dogs) and pericardial effusion.

Hormonal

When asked if any of their dogs have suffered from a hormonal condition(s), out of 98 responses, 2.04% said ‘yes’ and 97.96% said ‘no’.

The condition stated by the owners of the affected dog was a neuroendocrine tumour.

Neurological

No dogs had been affected by a neurological condition.

Renal/ kidney

No dogs had been affected by a renal condition.

Additional conditions not listed in study

The respondents were provided with the opportunity to note any conditions not already covered by the previous questions. The conditions listed from the owners were: two reports of tooth/ teeth removal, and then one for each of the following, gingivitis, cruciate ligament rupture, kidney failure, and asthma.

LITERATURE REVIEW

The literature review lays out the current scientific knowledge relating to the health of the breed. We have attempted to refer primarily to research which has been published in peer-reviewed scientific journals. We have also incorporated literature that was released relatively recently to try to reflect current publications and research relating to the breed. Some of the papers included within the literature review combine both the Smooth Fox Terrier and Wire Fox Terrier therefore should be interpreted with caution.

Endocrine conditions

Cushing's syndrome/ spontaneous hypercortisolism: Spontaneous hypercortisolism is caused by an abnormally high concentration of cortisol, a steroid hormone involved in the body's response to stress. An epidemiological study of 21,281 dogs that attended five Italian veterinary clinics (four private clinics and one University reference centre) between 2012-2014, investigated the risk factors for hypercortisolism (Carotenuto et al, 2019). The estimated prevalence of hypercortisolism was 0.2% across all four private clinics and 1.46% in the University reference centre. The authors found that the Fox Terrier (both breeds) had a significantly higher risk of developing spontaneous hypercortisolism compared to mixed breeds (OR 20.33; 95% CI 5.57–90.50, $p < 0.0001$). Female dogs of all breeds had higher risk of developing the disease compared to male dogs (OR 1.85; 95% CI 1.24–2.75) and all neutered dogs (both sexes) had higher risk compared non-neutered dogs (OR 2.54; 95% CI 1.72–3.73).

Eye conditions

Cataracts: A retrospective study investigated the prevalence of cataracts in dogs that attended North American teaching hospitals between 1964-2003 (Gelatt and MacKay, 2005). The overall prevalence of cataracts across breeds was seen to increase overtime, however the prevalence of cataracts in the Smooth Fox Terrier remained relatively consistent throughout. The Smooth Fox Terrier had the highest overall prevalence for the entire period analysed with 11.70% (20 out of 171 dogs of the breed) presenting with cataracts.

Neurological conditions

Canine neuropathies/ acral mutilation syndrome (AMS): Canine neuropathies are a group of neurological disorders characterised by progressive sensory loss and are commonly reported by veterinarians as AMS. The loss of sensation causes progressive self-mutilation of limb extremities, which can result in bleeding, ulceration and autoamputation. Correard et al (2019) identified a specific form of the disorder in two Fox Terriers (type unknown) where the pads were affected with numerous ulcerations and a loss of claws. In both cases, the clinical signs started at less than one year of age and significantly progressed resulting in euthanasia.

Hereditary ataxia/ spinocerebellar ataxia (SCA): Hereditary ataxia is neurological condition, which typically starts between two and six months of age and is characterised by progressive uncoordinated movements. Hereditary ataxia was first reported in the Smooth Fox Terrier in Sweden in the late 1950s (Björck et al, 1957). A subsequent study compared the neurological signs and histopathological abnormalities between Smooth Fox Terriers and Jack Russell Terriers with hereditary ataxia (Rohdin et al, 2015). They found that both breeds had the same characteristic gait abnormalities and similar neurological signs which indicated similar lesions in the brain. The authors concluded that these similarities between breeds suggest the same disease process is involved.

Similar clinical disease have since been reported in the Jack Russell Terrier and Parson Russell Terrier, however genetic analyses have indicated a different mode of inheritance between breeds. Rohdin et al (2015) investigated whether hereditary ataxia in the Smooth Fox Terrier was associated with either of the same mutations previously found in the Russell Terriers (*KCNJ10* and *CAPN1*). The authors found that three Smooth Fox Terriers with hereditary ataxia were all homozygous for the *KCNJ10* mutation, suggesting that this was the causal mutation for hereditary ataxia in the breed. A DNA test is available for the breed but not recognised by the KC.

Myasthenia gravis: Myasthenia gravis is a neuromuscular condition, typically characterised by muscle weakness and excessive fatigue. The condition is normally caused by a reduction in acetylcholine receptors (AChR – cellular receptors involved in the passing of chemical information between neural cells) and can be either acquired or congenital. An American study by Miller et al (1983) investigated the clinical signs in 13 Smooth Fox Terriers with myasthenia gravis. Clinical signs included muscle weakness (particularly during exercise), muscle wasting, megaoesophagus, and aspiration pneumonia. Unfortunately, the full paper could not be accessed but has been referenced at the end of the BHCP.

Further to this study, the same research group (Miller et al, 1984) analysed 132 Smooth Fox Terriers from 25 matings and suggested an autosomal recessive mode of inheritance with complete penetrance for this form of the condition in the breed. All the affected dogs died prior to sexual maturity despite treatment.

Urinary conditions

Canine calcium oxalate urolithiasis: Calcium oxalate uroliths (stones) in dogs form within the renal system and can be differentiated into calcium oxalate monohydrate

and calcium oxalate dihydrate. A retrospective Canadian study used epidemiological data to compare the two forms of calcium oxalate uroliths in dogs from 1979 to 2015. Of the 22,456 uroliths submitted, 6,690 (29.8%) were composed of 70% calcium oxalate. The Fox Terrier (both breeds) had increased odds for calcium oxalate monohydrate uroliths compared to all other breeds combined (OR 3.49; 95% C.I. 2.56 – 4.71). Dogs with these uroliths were significantly older than the dogs with calcium oxalate dihydrate uroliths.

VETCOMPASS

The Kennel Club work closely with VetCompass at the Royal Veterinary College. VetCompass is a broad welfare research programme that collects anonymised clinical information from more than 1800 UK veterinary practices and includes over 7.5 million dogs. VetCompass research can be used to identify common breed-specific conditions, or condition-specific concerns which affect a range of breeds. Whilst no breed specific VetCompass paper has yet been published for the Fox Terrier, the Fox Terrier (both Wire and Smooth breeds combined) is included in the condition-specific studies detailed below.

Urinary Conditions

Urinary incontinence: Of 109,428 male dogs attending 119 clinics throughout England, the Fox Terrier (both breeds) was established as one of five breeds considered to be predisposed to urinary incontinence, with a prevalence of 6.95% and an odds ratio of 9.60 (95% CI 3.68-25.05) compared with crossbreed dogs (Hall et al, 2018).

INSURANCE DATA

There are some important limitations to consider for insurance data:

- Accuracy of diagnosis varies between disorders depending on the ease of clinical diagnosis, clinical acumen of the veterinarian and facilities available at the veterinary practice
- Younger animals tend to be overrepresented in the insured population
- Only clinical events that are not excluded and where the cost exceeds the deductible excess are included

However, insurance databases are too useful a resource to ignore as they fill certain gaps left by other types of research; in particular they can highlight common, expensive and severe conditions, especially in breeds of small population sizes, that may not be evident from teaching hospital caseloads.

Swedish Agria Data

Swedish morbidity insurance data were available from Agria for the Fox Terrier (both Wire and Smooth breeds combined). Reported rates are based on dog-years-at-risk

(DYAR) which take into account the actual time each dog was insured during the period (2011-2016) e.g. 1 DYAR is equivalent to one whole year of insurance. The number of DYAR for Fox Terriers in Sweden during this period was between 500 and 1,000, so the results should be interpreted with caution.

Swedish Agria insurance morbidity data

Specific causes for veterinary care episodes

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Fox Terrier (both breeds) in Sweden between 2011 and 2016 are shown in Figure 2. The top five specific causes of VCEs were vomiting/ diarrhoea/ gastroenteritis, skin trauma, skin tumour, polyuria/ polydipsia (excessive urinating/ drinking), and signs of pain (locomotor system).

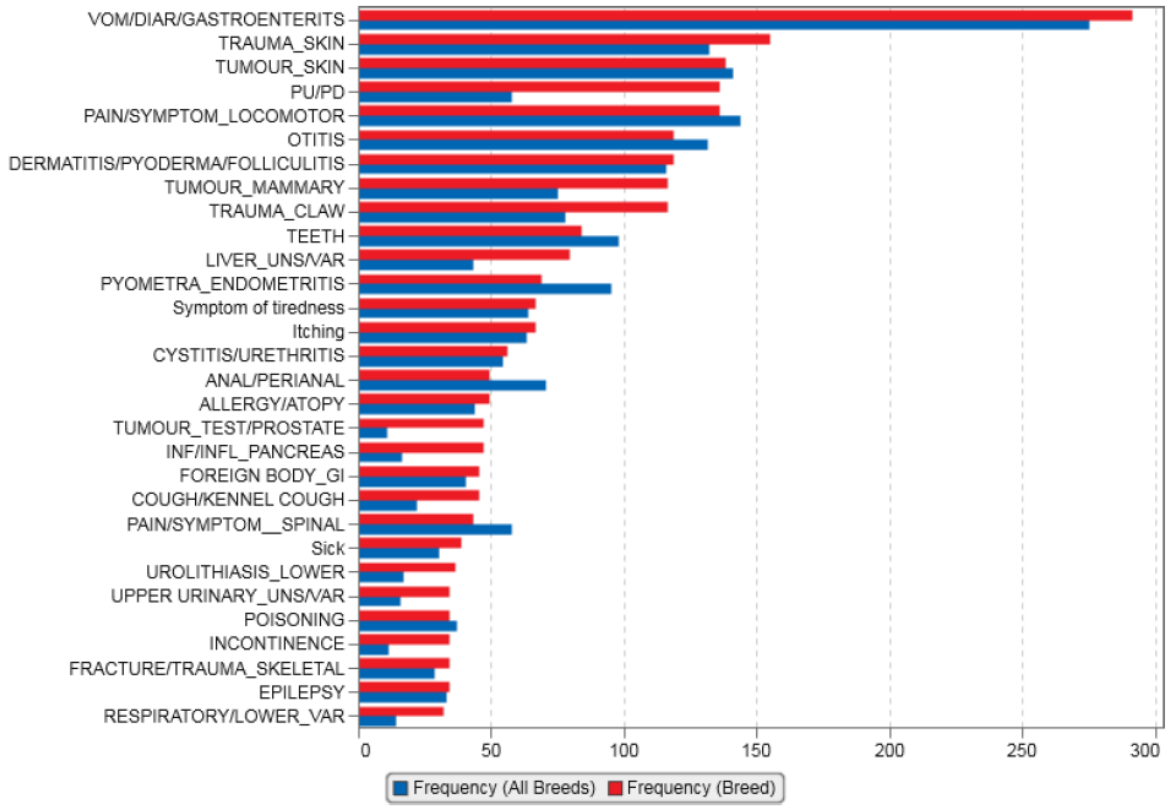


Figure 2: The most common specific causes of VCEs for the Fox Terrier (both breeds) compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

Relative risk for veterinary care episodes

The specific causes of VCEs ordered by relative risk are shown in Figure 3 for the Fox Terrier (both breeds). In this analysis, the top five specific causes of VCEs ordered by relative risk were teste/ prostate tumour, anal tumour, heart – unspecified/ various, incontinence and infection/ inflammation of the pancreas. Rare conditions that occur sporadically may appear as a high relative risk; this caveat may well apply to some of these conditions.

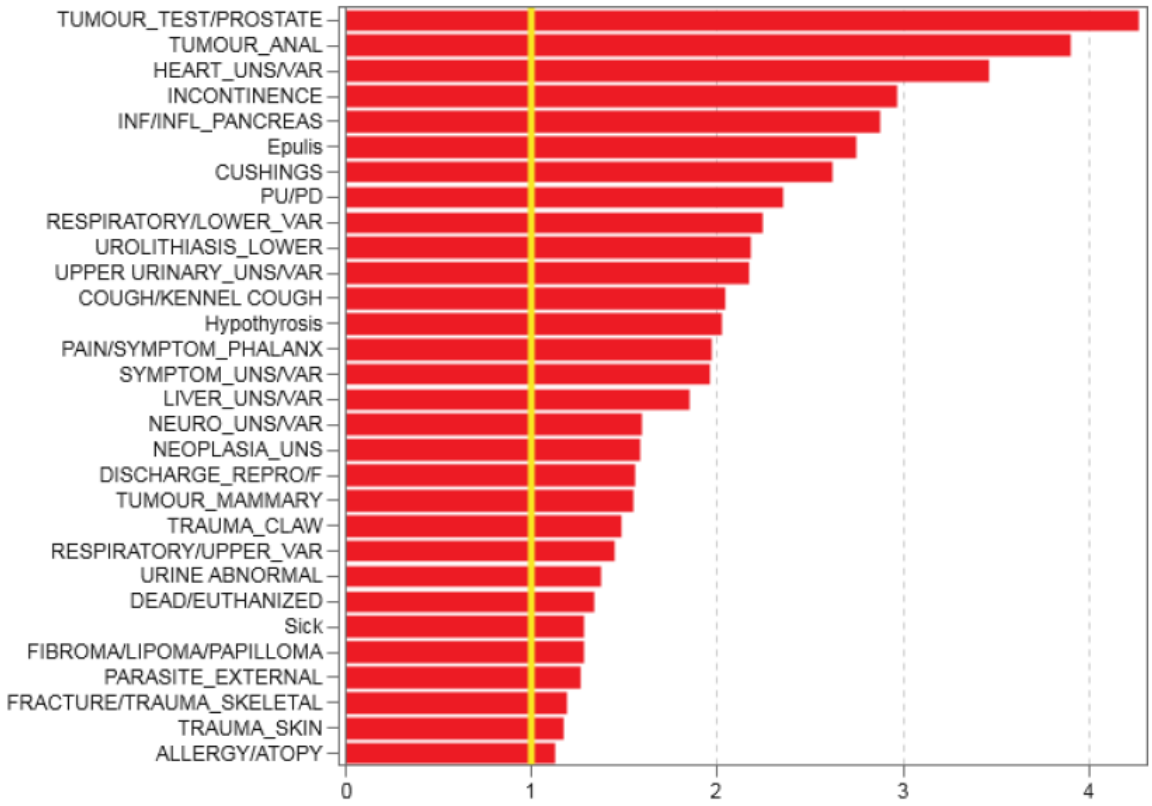


Figure 3: The specific causes of VCEs for the Fox Terrier (both breeds) ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

Further to this, the breed's morbidity of locomotory problems/ concerns were compared to all breeds (Figure 4). Unspecified/ various locomotor disorders were the most frequent type in the breed, with spinal disorders being the highest specific disorder, followed by disorders of the knee/ patellar.

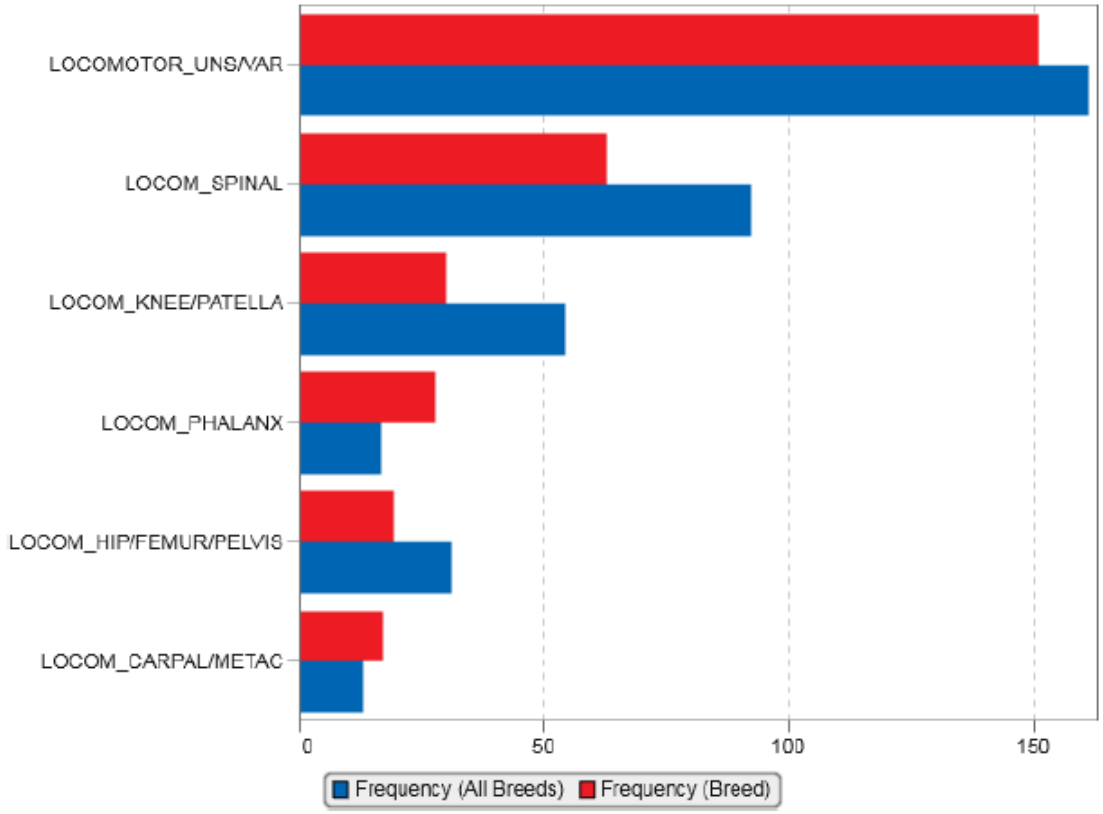


Figure 4: The morbidity of locomotor problems in the Fox Terrier (both breeds) in comparison to all breeds in the Swedish Agria database between 2011-2016.

When the relative risk was considered, the top locomotory disorder was in the phalanx, followed by the carpus/ metacarpus (Figure 5).

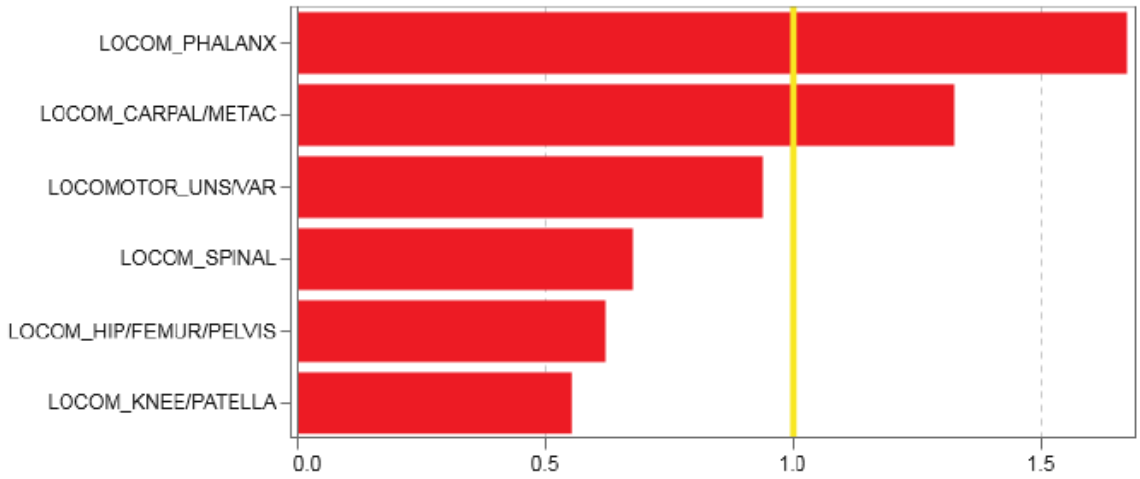


Figure 5: The specific causes of locomotory disorder for the Fox Terrier (both breeds) ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

BREED WATCH

The Smooth Fox Terrier is a category one breed, meaning judges are not required to complete mandatory monitoring forms following an appointment as championship certificate level. To date no optional reports have been received for the breed.

PERMISSION TO SHOW

As of the 1st January 2020 exhibits for which permission to show (PTS) following surgical intervention has been requested will no longer be published in the Breed Record Supplement and instead will be detailed in BHCPs, and a yearly report will be collated for the BHC. In the past five years, four reports have been received for the Smooth Fox Terrier (excluding neutering or caesarean sections), these were 'tail partially amputated', 'root canal treatment', 'tail docked overseas' and 'umbilical hernia'.

ASSURED BREEDERS SCHEME

Currently within the Kennel Club (KC)'s Assured Breeders Scheme there are the following requirements for the Smooth Fox Terrier:

- Eye Testing under the BVA/KC/ISDS Eye Scheme

There are currently no recommendations within the Kennel Club (KC)'s Assured Breeders Scheme for the Smooth Fox Terrier.

BREED CLUB BREEDING RECOMMENDATIONS

There are not currently any Breed Club breeding recommendations listed on the Kennel Club's website for the breed.

DNA TEST RESULTS

Currently there are no recognised DNA tests for the Smooth Fox Terrier.

Whilst DNA tests may be available for the breed, results from these will not be accepted by the Kennel Club until the test has been formally recognised, the process of which involves collaboration between the breed clubs and the Kennel Club in order to validate the test's accuracy.

CANINE HEALTH SCHEMES

All of the British Veterinary Association (BVA)/Kennel Club (KC) Canine Health Schemes are open to dogs of any breed with a summary given of dogs tested to date below.

EYES

The Smooth Fox Terrier is currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for the following condition:

- Primary Lens Luxation (PLL)

KIOD lists the known inherited eye conditions in the breeds where there is enough scientific information to show that the condition is inherited in the breed, often including the actual mode of inheritance and in some cases even a DNA test.

Just three Smooth Fox Terriers have been tested since the scheme began, with two of these unaffected and one “test results with owner” (meaning a non-KIOD disorder was detected).

As well as the KIOD list, the BVA record any other conditions affecting a dog at the time of examination, which is incorporated into an annual sightings report. Between 2012 and 2018, just two Smooth Fox Terriers were eye tested under the BVA/KC/ISDS Eye Scheme and no comments were made.

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 1 below for conditions affecting over 1% of the examined population. Between 2015 and 2019, 66 Smooth Fox Terriers were examined, of which 81.8% (54 of 66 dogs) were found to be unaffected by any eye condition.

Whilst it is important to note that these data represent dogs in America, the organisation tend to examine a higher number of dogs than that in the UK, and therefore are a valuable source of information.

Table 1: ACVO examination results for Smooth Fox Terrier, 1991 – 2019

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n=262)	**2015-2019** (n=66)
Uvea		
Persistent pupillary membranes, iris to iris	5.0%	1.5%
Lens		
Cataract, suspect not inherited/significance unknown	1.1%	0.0%
Significant cataracts (summary)	1.9%	0.0%
Vitreous		
Vitreal degeneration	1.1%	1.5%
Retina		
Retinal dysplasia, folds	0.4%	3.0%

Adapted from: https://www.ofa.org/diseases/eye-certification/blue-book

REPORTED CAESAREAN SECTIONS

When breeders register a litter of puppies, they are asked to indicate whether the litter was delivered (in whole or in part) by caesarean section. In addition, veterinary surgeons are asked to report caesarean sections they perform on Kennel Club registered bitches. The consent of the Kennel Club registered dog owner releases the veterinary surgeon from the professional obligation to maintain confidentiality (vide the Kennel Club General Code of Ethics (2)).

There are some caveats to the associated data;

- It is doubtful that all caesarean sections are reported, so the number reported each year may not represent the true proportion of caesarean sections undertaken in each breed.
- These data do not indicate whether the caesarean sections were emergency or elective.
- In all breeds, there was an increase in the number of caesarean sections reported from 2012 onwards, as the Kennel Club publicised the procedure to vets.

The number of litters registered per year for the breed and the number and percentage of reported caesarean sections in the breed for the past 10 years are shown in Table 2.

Table 2: Number of Smooth Fox Terrier litters registered per year, and number and percentage of caesarean sections reported per year, 2009 to 2019.

Year	Number of Litters Registered	Number of C-sections	Percentage of C-sections	*Percentage of C-sections out of all KC registered litters (all breeds)*
2009	26	0	0.00%	0.15%
2010	43	0	0.00%	0.35%
2011	0	0	0.00%	1.64%
2012	26	1	3.85%	8.69%
2013	27	3	11.11%	9.96%
2014	32	2	6.25%	10.63%
2015	31	0	0.00%	11.68%
2016	27	1	3.70%	13.89%
2017	20	1	5.00%	15.00%
2018	28	0	0.00%	17.21%
2019	27	0	0.00%	15.70%

GENETIC DIVERSITY MEASURES

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the 'gene pool' of the breed. In the population analysis undertaken by the Kennel Club in 2020, an estimated effective population size of **350.3** was reported (estimated using the rate of inbreeding over the period 1980-2019).

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated 'random mating') over the period 1980-2019 are shown in Figure 6. The rate of observed inbreeding gradually increased until a peak in 2001. Since this time the rate has notably decreased, although with some fluctuation, implying breeders have been carefully selecting mates to restore the diversity in the breed. This decrease may also be due to the potential introduction of new genetic material from imported animals.

It should be noted that, while animals imported from overseas may appear completely unrelated, this is not always the case. Often the pedigree available to the Kennel Club is limited in the number of generations, hampering the ability to detect

true, albeit distant, relationships. Imported dogs, and their progeny, should be used carefully and with moderation to avoid loss of further genetic diversity in the breed.

For full interpretation see Lewis et al, 2015 https://cgejournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4.

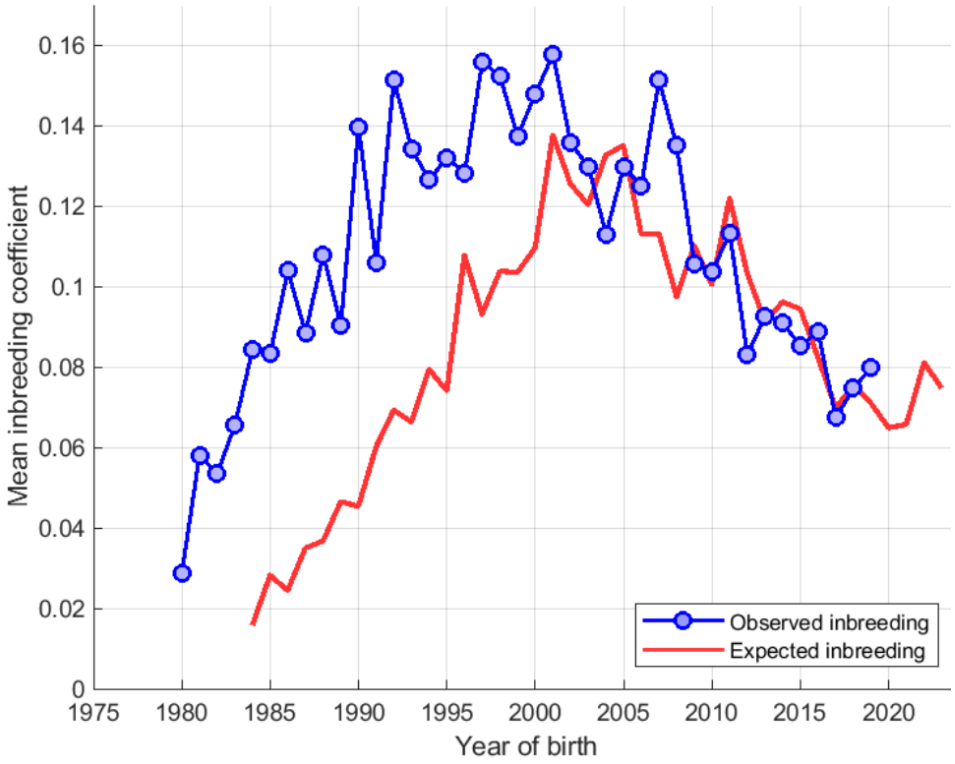


Figure 6: Annual mean observed and expected inbreeding coefficients.

The current annual breed average inbreeding coefficient is **8.0%**.

Below is a histogram ('tally' distribution) of proportion of progeny per sire and dam over each of eight 5-year blocks (Figure 7). A longer 'tail' on the distribution of progeny per sire is indicative of 'popular sires' (few sires with a very large number of offspring, known to be a major contributor to a high rate of inbreeding).

Throughout the period analysed, there is evidence of several popular sires being used in the breed, with one sire responsible for approximately 8% of progeny registered between 2015 and 2019. Given the small breeding population of the breed, it is acknowledged that this is difficult to avoid but nevertheless should be monitored.

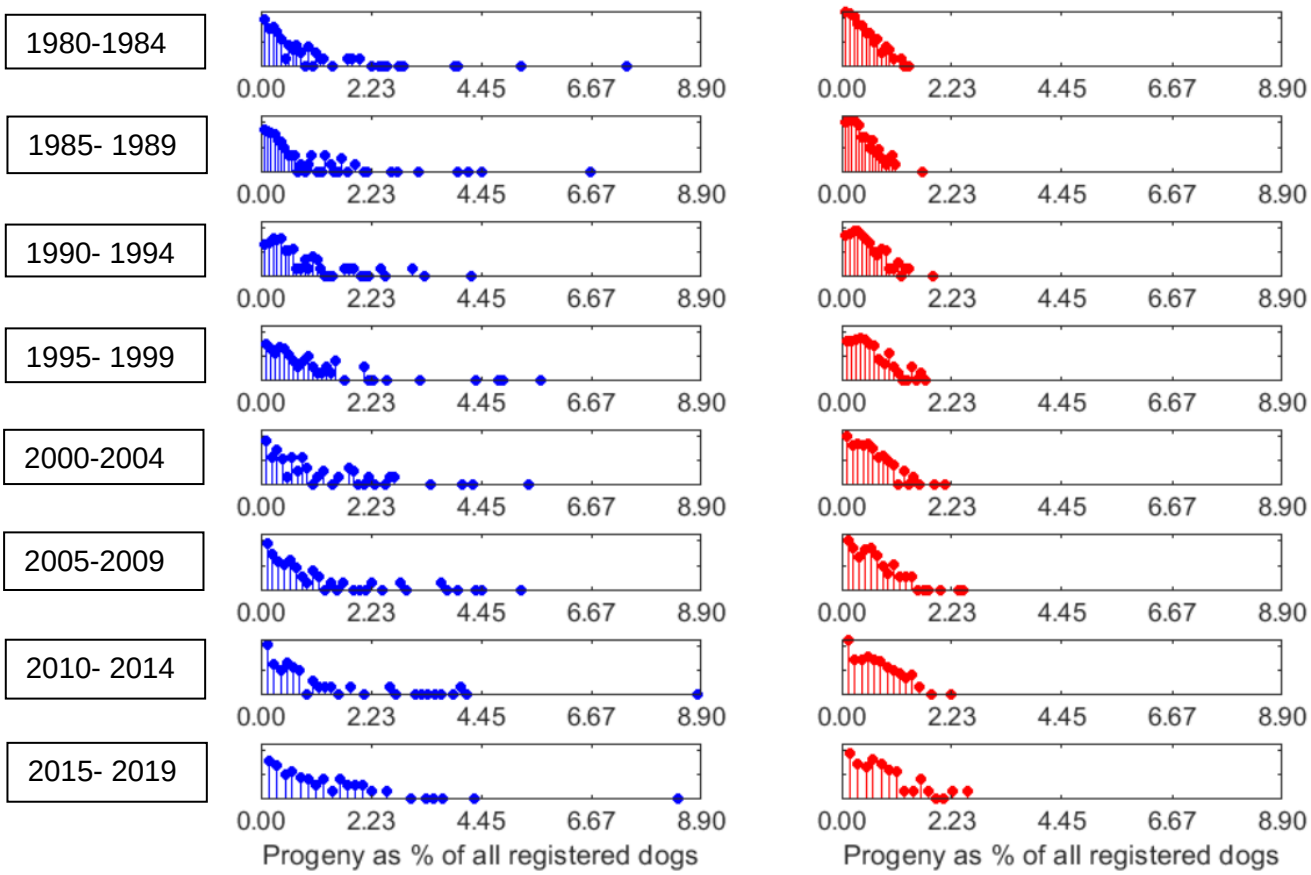


Figure 7: Distribution of the proportion of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2014-19 bottom). Vertical axis is a logarithmic scale

CURRENT RESEARCH

The breed are not involved in any active research at this time.

PRIORITIES

Correspondence between the breed representatives and the Kennel Club was undertaken in July 2021 to discuss the evidence base of the BHCP and agree the priority issues for the health of the breed. The group agreed from the evidence base that the priorities for the Smooth Fox Terrier were:

- Monitoring health conditions in the breed
- Genetic diversity

ACTION PLAN

Following the correspondence between the Kennel Club and the breed regarding the evidence base of the Breed Health & Conservation Plans, the following actions were agreed to improve the health of the Smooth Fox Terrier. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Breed Clubs to add a webpage relevant to health on their websites.
- The Breed Clubs to continue to encourage eye testing under the BVA/KC/ISDS Eye Scheme, primarily to collate data to support that PLL is not a concern in the breed and assess prevalence of cataracts in the UK population.
- The Breed Clubs to continue to monitor the use of popular sires and raise awareness of the importance of considering genetic diversity when breeding.
- The Breed Clubs to maintain and expand collaborations with international breed clubs.
- The Breed Clubs to consider requesting the recognition of the SCA DNA test.
- The Breed Clubs to consider developing a reporting database, with the Kennel Club to assist in development and dissemination, as needed.

Kennel Club actions include:

- The Kennel Club to produce a piece on the importance of considering genetic diversity and popular sires when breeding, specifically for numerically small breeds.
- The Kennel Club to provide analysis for UK insurance data for the breed.
- The Kennel Club to approach the BVA/KC Eye Panel Working Group to propose the breed's removal from KIOD for PLL, once a sufficient number of dogs have been tested to provide supporting data

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