THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan

Boxer

Evidence Base

BHCP/Version 3/September 2021

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 Boxers registered by year of birth between 1990 and 2020 are shown in Figure 1. The registrations for the breed appeared to peak in 1997 and have since gradually decreased. Statistically, the trend of registrations over year of birth (1990-2020) was -214.5 per year (with a 95% confidence interval of -282.0 to -146.9), reflecting the overall decrease in the breed's numbers.

[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.]

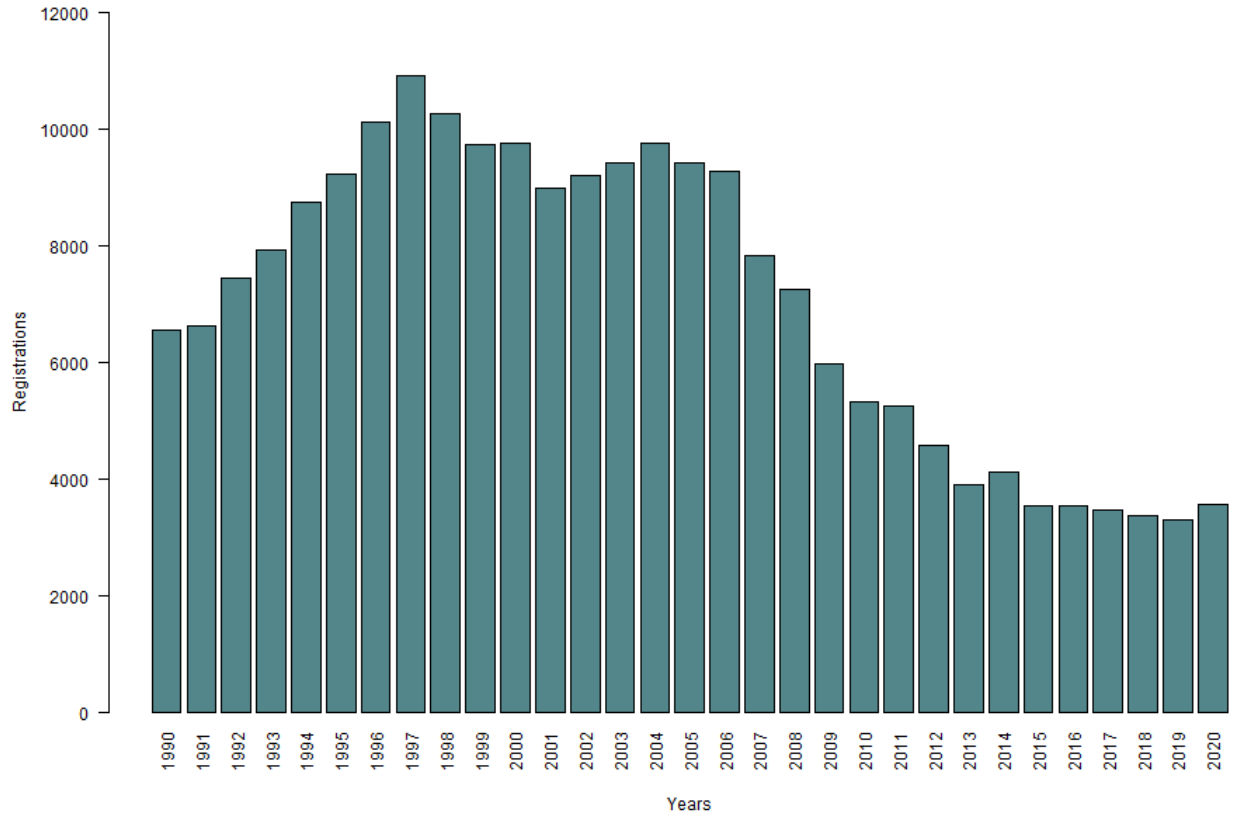

Figure 1: Number of registrations of Boxers per year of birth, 1990 – 2020.

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.

The Breed Health Coordinators Annual Health Report 2018 yielded the following response to 'please list and rank the three health and welfare conditions that the breed considers to be currently the most important to deal with in your breed':

1. Cancer
2. Heart conditions (aortic stenosis and cardiomyopathy)
3. Juvenile kidney disease (JKD)

New actions listed sending DNA swabs to AHT, collecting data through the Breed Council and ongoing research into conditions affecting the breed. The breed have also been encouraging owners to report cases of aortic stenosis and cardiomyopathy (link below), and collating information on dogs affected with JKD, with samples being sent to the Broad Institute in America for histology and to Prof Syme at the Royal Veterinary College for analysis.

BREED CLUB HEALTH ACTIVITES

The breed has an active Breed Health Coordinator and a dedicated health page on the Boxer Breed Council's website: http://www.boxerbreedcouncil.co.uk/health.html .

The Boxer Breed Council requests that all cases of aortic stenosis or ARVC are reported to the health committee; this can be done via the website with the following link: http://www.boxerbreedcouncil.co.uk/as.html

BREED SPECIFIC HEALTH SURVEYS

Kennel Club Pedigree Dog Health Surveys Results

The Kennel Club Pedigree Dog Health Survey was launched in 2014 for all of the recognised breeds at the time, to establish common breed-specific and breed-wide conditions.

2004 Morbidity results: Health information was collected for 249 live Boxers of which 144 (58%) were healthy and 105 (42%) had at least one reported health condition. The top categories of diagnosis were reproductive (13.3%, 29 of 218 reported conditions), cardiac (11.9%, 26 of 218 reported conditions), dermatologic (10.6%, 23 of 218 reported conditions) and ocular (9.2%, 20 of 218 reported conditions). The most frequently reported specific conditions were kennel cough (7.2% prevalence, 18 cases), hypothyroidism (6.4% prevalence, 16 cases), corneal ulcer (6.0%, 15 cases) and false pregnancy (5.4% prevalence, 8 cases in the 147 female Boxers in the dataset).

2004 Mortality results: A total of 130 deaths were reported for the breed. The median age at death for Boxers was 10 years and 3 months (min = 4 months, max = 15 years and 3 months). The most frequently reported causes of death by organ system or category were cancer (38.5%, 50 of 130 deaths), old age (21.5%, 28 deaths), cardiac (6.9%, 9 deaths) and gastrointestinal (6.9%, 9 deaths). Apart from cancer and old age, the most frequently reported specific cause of death was GDV (5.4%, 7 deaths).

2014 Morbidity results: Health information was collected for 724 live Boxers of which 333 (46.0%) had no reported conditions and 391 (54.0%) were reported to be affected by at least one condition. The most frequently reported specific conditions were skin (cutaneous) cyst (5.4% prevalence, 49 cases), skin cancer/tumour (5.3%, 48cases), hypersensitivity (allergic) skin disorder (4.6%, 42 cases), lipoma (4.3%, 39 cases) and skin lump (4.1%, 37 cases). Further analysis of the morbidity results suggested that the Boxer was at increased risk of alopecia/baldness, arthritis, DCM, colitis, corneal ulcer, cruciate disease, cruciate ligament injury, cryptorchidism, ear lump, epulis, food allergy, heart (cardiac) murmur, hypersensitivity (allergic) skin disorder, hypothyroidism, irregular heartbeat, kennel cough, oral (mouth) lump, pancreatitis, skin (cutaneous) cyst, skin cancer/tumour, skin lump, spondylosis,

steroid responsive meningitis/arteritis, unspecified tumour/cancer and urinary incontinence compared to the average risk for dogs of all breeds (Wiles et al, 2017).

2014 Mortality results: A total of 172 deaths were reported for the breed. The median age at death for Boxers was 9 years (min = 0 year, max = 14 years). The most frequently reported causes of death were brain tumour (15.1%, 26 deaths), cancer - unspecified (12.2%, 21 deaths), cardiac (heart) failure (7.0%, 12 deaths) and lymphoma (6.4%, 11 deaths).

2020 Boxer Health Survey

After removing all unusable responses (for example, respondents did not consent to Boxer Breed Clubs and the Kennel Club using the data for research purposes) a total of 2,865 individual responses remained, representing 3,969 dogs.

When asked how many Boxers were owned, out of 2,865 responses, the majority, 2,219 (77.5%) answered '1'. The remaining percentages are given in Figure 2 below.

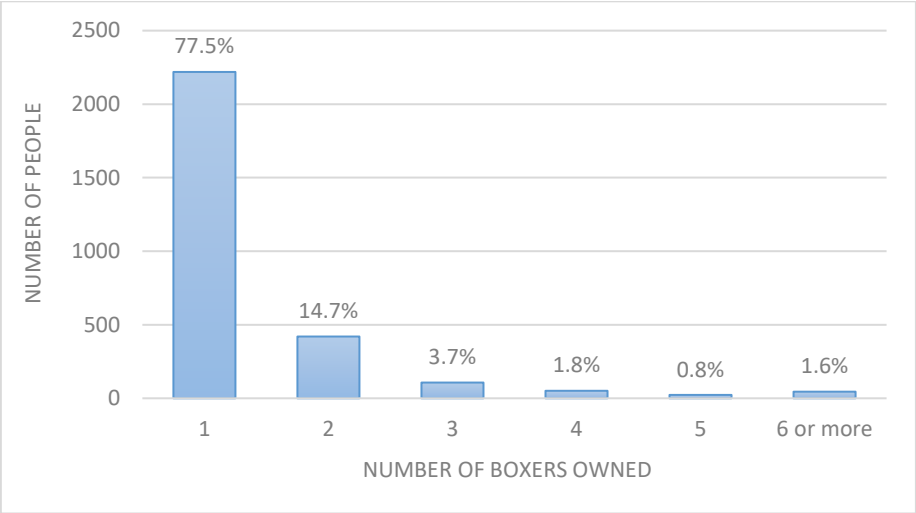

Figure 2: Number of Boxers owned per person completing the survey

When asked the sex of the dog(s), out of 3,284 dogs, 48.6% were male and 51.4% were female. Out of 3,283 dogs, 47.1% were entire and 52.9% were neutered. Results are shown in Table 1.

Table 1: Sex and neutered status of Boxers included in the survey

Sex	**Neutered Status**			**Total**
	Entire	Neutered	Unanswered	
Female	737 (22.4%)	952 (29.0%)	0	**1,689**
Male	809 (24.6%)	785 (23.9%)	1	**1,595**
Total	**1,546**	**1,737**	**1**	**3,284**

The median weight of the Boxers included in the survey was 30kg. Table 2 shows how active the Boxers included in this survey were considered to be, with the majority considered to be moderately active (44.1%, 1,364 of 3,093).

Table 2: Activity levels of Boxers included in the survey, as perceived by their owners

Activity	Number of dogs	Percentage
Highly active	1,355	43.8%
Mildly active	336	10.9%
Moderately active	1,364	44.1%
Not at all	38	1.2%
Total	**3,093**	

Health

The survey investigated the number of dogs affected by specific conditions within different categories. Within each of these categories, the respondents were given a choice of specific conditions, the choices of “not known” and “other” were also given.

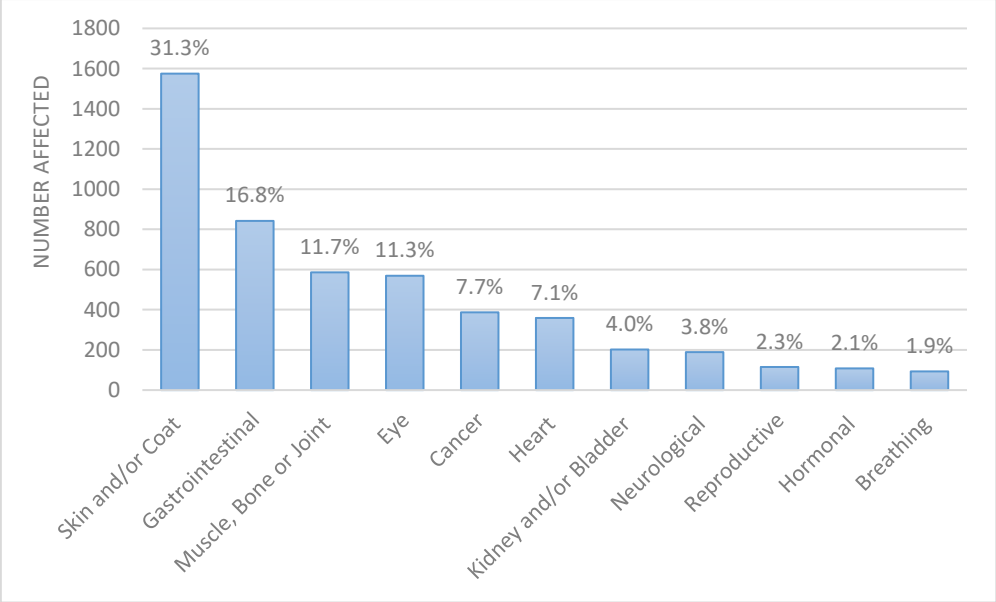

Figure 3: Overall summary of Boxer conditions reported in the survey

The data collected from this survey represents the total number of conditions selected by respondents about their dog(s). One dog might be affected by more than one condition (e.g. one dog may be affected by both food and environmental allergies) therefore the data often shows more conditions reported per category than number of dogs in that category.

The total number of specific conditions reported in this survey was 5,025. Out of the 5,025 specific conditions reported 31.3% were for ‘Skin and/or Coat’, 16.8% were for ‘Gastrointestinal’, 11.7% were for ‘Muscle, Bone or Joint’, 11.3% were for ‘Eye’ and 7.7% were for ‘Cancer’. The results for each category are given in Table 3.

Table 3: Overall summary of Boxer conditions reported in the survey

Body system	Number affected	Percentage
Skin and/or Coat	1,575	31.3%
Gastrointestinal	842	16.8%
Muscle, Bone or Joint	586	11.7%
Eye	569	11.3%
Cancer	387	7.7%
Heart	359	7.1%
Kidney and/or Bladder	202	4.0%
Neurological	189	3.8%
Reproductive	115	2.3%
Hormonal	108	2.2%
Breathing	93	1.9%
TOTAL	**5,025**	

Please note: the total number of dogs affected by a 'Dental', 'Haematological' or 'Hepatic' condition are not included in the summary above because prior to the survey, these were not considered to be a concern within the breed and therefore the total number of dogs affected by specific conditions within each category was not collected.

Nevertheless, 259 owners reported that their dog(s) had been affected by a dental condition, 12 owners reported that their dog(s) had been affected by a haematological condition and 8 owners reported that their dog(s) had been affected by a hepatic condition.

Skin and/or Coat Conditions

When asked if any of their dogs have suffered from a skin and/or coat condition(s), out of the 1,988 responses, 869 (43.7%) answered "Yes" and 1,119 (56.3%) answered "No".

The total number of individual skin and/or coat conditions reported was 1,575. Of these, the most commonly reported condition was allergies – dust, mites, pollen, which affected 16.5% of the study sample (260 of 1,575). This was followed by allergies – unknown (13.3%), excessive ear wax (11.3%), dermatitis (9.5%) and allergies – food (8.3%). Table 4 shows the total number and percentage of dogs affected by each reported skin and/or coat condition in descending order.

Table 4: Number and percentage of Boxers affected by each specific skin and/or coat condition, as reported in the survey

Specific condition	Number affected	Percentage
Allergies (dust, mites, pollen)	260	16.5%
Allergies - unknown	210	13.3%
Excessive ear wax	178	11.3%
Dermatitis	150	9.5%
Allergies (food)	130	8.3%
Alopecia (hair loss)	129	8.2%
Skin cysts	95	6.0%
Lipoma	89	5.7%
Otitis externa	83	5.3%
Otitis media	75	4.8%
Pyoderma	22	1.4%
Pyotraumatic dermatitis	22	1.4%
Demodectic/sarcoptic mange	13	0.8%
Calcinosis circumscripta	3	0.2%
Not known	21	1.3%
Other	95	6.0%
Total	**1575**	

The most common answers to “other” for skin and/or coat conditions not already listed in the survey were: ear infection (n=13), yeast infection (n=7), histiocytoma (n=6), and acne (n=6).

Gastrointestinal Conditions

When asked if any of their dogs have suffered from a gastrointestinal condition(s), out of the 2,077 responses, 579 (27.9%) answered “Yes” and 1,498 (72.1%) answered “No”.

The total number of individual gastrointestinal conditions was 842. Of these, the most commonly reported condition was food allergies/intolerance, which affected 21.4% of the study sample (180 of 842). This was followed by colitis (15.2%), chronic diarrhoea (12.6%), pancreatitis (11.5%), and gastroenteritis (9.0%). Table 5 shows the total number and percentage of dogs affected by each reported gastrointestinal condition in descending order.

Table 5: Number and percentage of Boxers affected by each specific gastrointestinal condition, as reported in the survey

Specific condition	Number affected	Percentage
Food allergies/intolerance	180	21.4%
Colitis	128	15.2%
Chronic diarrhoea	106	12.6%
Pancreatitis	97	11.5%
Gastroenteritis	76	9.0%
Flatulence	66	7.8%
Inflammatory bowel disease (IBD)	35	4.2%
Chronic vomiting	31	3.7%
Regurgitation	28	3.3%
Impacted anal glands	17	2.0%
Constipation	5	0.6%
GDV/bloat	5	0.6%
Histiocytic ulcerative colitis	5	0.6%
Megaoesophagus	4	0.5%
Cleft palate	1	0.1%
Inguinal hernia	1	0.1%
Not known	19	2.3%
Other	38	4.5%
Total	**842**	

The most common answers to “other” for gastrointestinal conditions not already listed in the survey were: diarrhoea (n=8), giardia (n=8), sensitive stomach (n=7), vomiting (n=4), and obstruction (n=3).

Muscle, Bone or Joint Conditions

When asked if any of their dogs have suffered from a muscle, bone or joint condition(s), out of the 2,024 responses, 466 (23.0%) answered “Yes” and 1,558 (77.0%) answered “No”.

The total number of individual muscle, bone or joint conditions reported was 586. Of these, the most commonly reported condition was cranial cruciate ligament rupture, which affected 31.1% of the study sample (182 of 586). This was followed by osteoarthritis (18.3%), hip dysplasia (8.2%), chronic lameness (4.4%), and elbow dysplasia (2.7%). Table 6 shows the total number and percentage of dogs affected by each reported muscle, bone or joint condition in descending order.

Table 6: Number and percentage of Boxers affected by each specific muscle, bone or joint condition, as reported in the survey

Specific condition	Number affected	Percentage
Cranial cruciate ligament rupture (CCLR)	182	31.1%
Osteoarthritis (OA)	107	18.3%
Hip dysplasia	48	8.2%
Chronic lameness	26	4.4%
Elbow dysplasia	16	2.7%
Osteochondritis dissecans of the shoulder	10	1.7%
Carpal laxity syndrome	8	1.4%
Patellar luxation	8	1.4%
Osteochondritis dissecans (OCD) of the elbow	5	0.9%
Osteochondritis dissecans (OCD) of the hock	5	0.9%
Panosteitis (growing pains)	4	0.7%
Diffuse idiopathic skeletal hyperostosis (DISH)	3	0.5%
Osteochondritis dissecans (OCD) - unknown	2	0.3%
Not known	38	6.5%
Other	124	21.2%
Total	**586**	

The most common answers to “other” for muscle, bone or joint conditions not already listed in the survey were: spondylosis (n=21), spondylitis (n=11), stiffness (n=9), lameness (n=5), and trauma/injury (n=4).

Eye Conditions

When asked if any of their dogs have suffered from an eye condition(s), out of the 2,100 responses, 462 (22.0%) answered “Yes” and 1,638 (78.0%) answered “No”.

The total number of individual eye conditions reported was 569. Of these, the most commonly reported condition was corneal ulceration, which affected 62.4% of the study sample (355 of 569). This was followed by distichiasis (5.3%), entropion (3.7%), chronic discharge (3.2%), and cataract (not-inherited) (2.8%). Table 7 shows the total number and percentage of dogs affected by each reported eye condition in descending order.

Table 7: Number and percentage of Boxers affected by each specific eye condition, as reported in the survey

Specific condition	Number affected	Percentage
Corneal ulcer	355	62.4%
Distichiasis	30	5.3%
Entropion	21	3.7%
Chronic discharge	18	3.2%
Cataract (non-inherited)	16	2.8%
Corneal lipid deposition	15	2.6%
Ectropion	11	1.9%
Glaucoma	6	1.1%
Prolapsed gland	6	1.1%
Keratoconjunctivitis sicca	5	0.9%
Uveal cysts	4	0.7%
Pigmentary keratitis	3	0.5%
Persistent pupillary membrane (PPM)	2	0.4%
Hereditary cataract	1	0.2%
Not known	23	4.0%
Other	53	9.3%
Total	**569**	

The most common answers to “other” for eye conditions not already listed in the survey were: conjunctivitis (n=11), ulcers (n=7), trauma (n=6), infection (n=5), and allergies (n=3).

Cancer

When asked if any of their dogs have suffered from cancer, out of the 2,134 responses, 324 (15.2%) answered “Yes” and 1,810 (84.8%) answered “No”.

The total number of individual cancers reported was 387. Of these, the most commonly reported type of cancer was mast cell tumour, which affected 49.6% of the study sample (192 of 387). This was followed by melanoma (6.2%), lymphoma (5.9%), brain tumour (5.7%), and histiocytoma (5.4%). Table 8 shows the total number and percentage of dogs affected by each cancerous condition in descending order.

Table 8: Number and percentage of Boxers affected by each specific cancerous condition, as reported in the survey

Specific condition	Number affected	Percentage
Mast cell tumour	192	49.6%
Melanoma	24	6.2%
Lymphoma	23	5.9%
Brain tumour	22	5.7%
Histiocytoma	21	5.4%
Mammary tumour	21	5.4%
Anal sac tumour	9	2.3%
Osteosarcoma	9	2.3%
Thyroid tumour	4	1.0%
Testicular tumour	3	0.8%
Vascular/ blood tumour	1	0.3%
Not known	17	4.4%
Other	40	10.3%
Total	**387**	

The most common answers to “other” for cancerous conditions not already listed in the survey were:” were sarcoma (n=5), pancreatic cancer (n=5), and lung cancer (n=3).

The median age that affected dogs were diagnosed with cancer was 6 years. Figure 3 shows the total number of dogs affected by cancer per year of age.

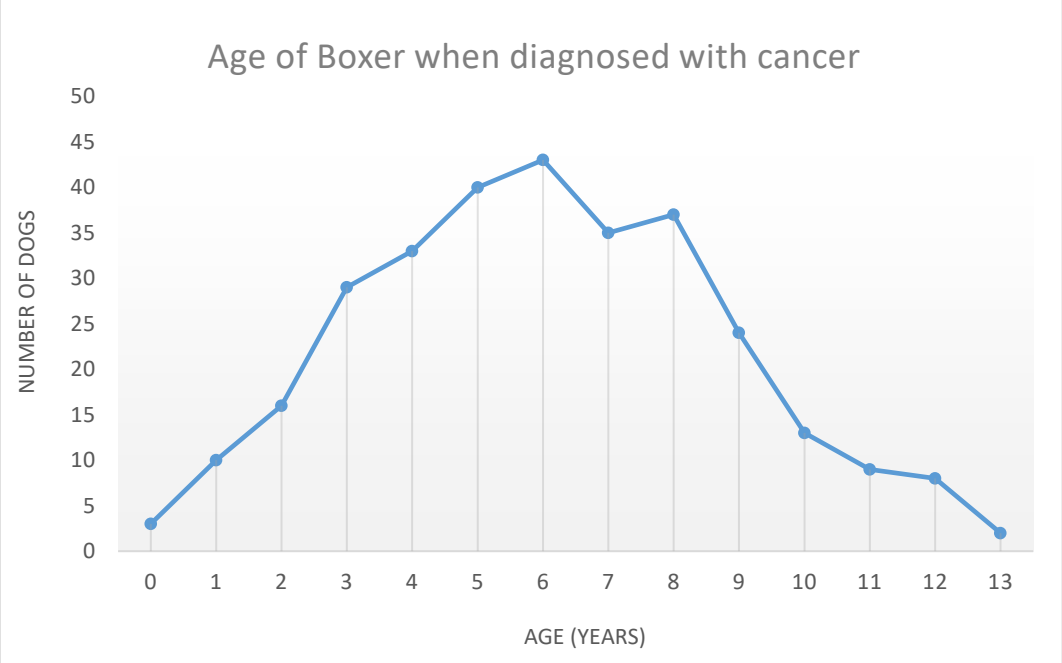

Figure 3: The age of Boxers when diagnosed with cancer, as reported in the survey

Heart Conditions

When asked if any of their dogs have suffered from a heart condition(s), out of the 2,053 responses, 305 (14.9%) answered “Yes” and 1,748 (85.1%) answered “No”.

The total number of individual heart conditions reported was 359. Of these, the most commonly reported condition was heart murmur, which affected 61.8% of the study sample (222 of 359). This was followed by aortic stenosis/subaortic stenosis (13.9%), dilated cardiomyopathy (DCM) (6.4%), irregular heart rate and/or rhythm (6.1%), and heart attack (2.8%). Table 9 shows the total number and percentage of dogs affected by each reported heart condition in descending order.

Table 9: Number and percentage of Boxers affected by each specific heart condition, as reported in the survey

Specific condition	Number affected	Percentage
Heart murmur	222	61.8%
Aortic stenosis/subaortic stenosis	50	13.9%
Dilated cardiomyopathy (DCM)	23	6.4%
Irregular heart rate and/or rhythm	22	6.1%
Heart attack	10	2.8%
Arrhythmogenic right ventricular cardiomyopathy (ARVC)	6	1.7%
Myocarditis/ Endocarditis	2	0.6%
Mitral valve dysplasia (MVD)	1	0.3%
Not known	7	2.0%
Other	16	4.5%
Total	**359**	

The most common answers to “other” for heart conditions not already listed in the survey were: leaking valves (n=5), collapse (n=2), tricuspid valve dysplasia (n=2), and abnormal heart beat (n=2).

The median age that affected dogs were diagnosed with a heart condition was 1 year and 8 months. Figure 4 shows the total number of dogs affected by a heart condition per year of age.

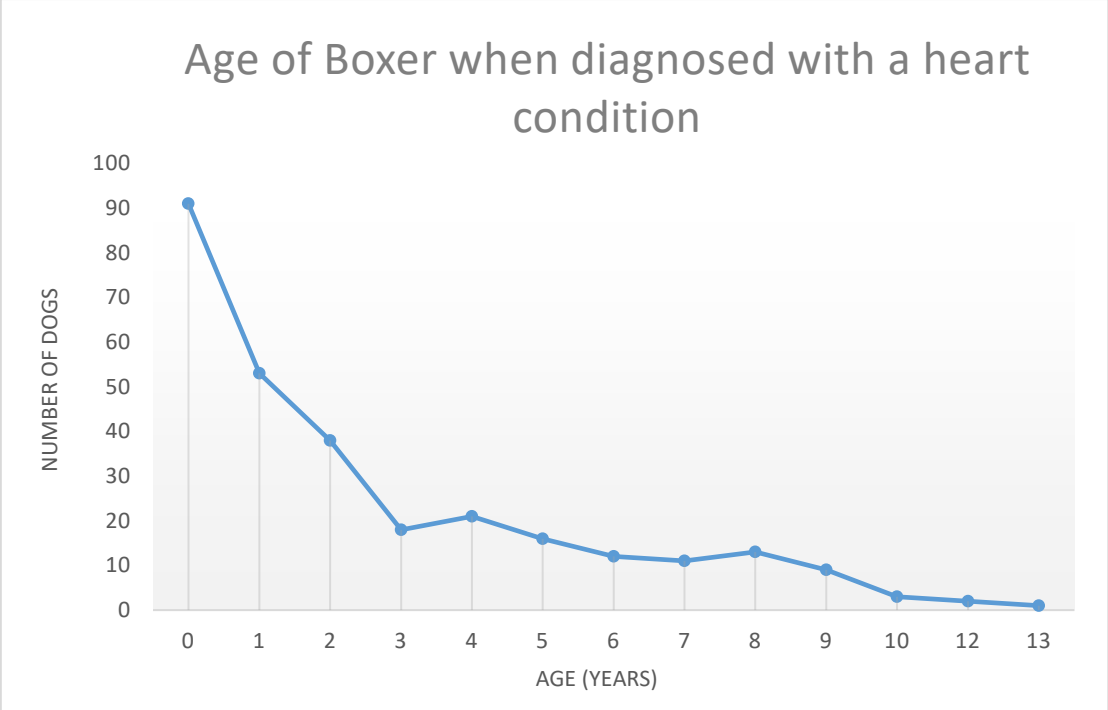

Figure 4: The age of Boxers when diagnosed with a heart condition, as reported in the survey

Kidney and/or Bladder Conditions

When asked if any of their dogs have suffered from a kidney and/or bladder condition(s), out of the 2,027 responses, 169 (8.3%) answered “Yes” and 1,858 (91.7%) answered “No”.

The total number of individual kidney and/or bladder conditions reported was 202. Of these, the most commonly reported condition was urinary tract infection (UTI), which affected 36.1% of the study sample (73 of 202). This was followed by urinary incontinence (29.7%), juvenile kidney disease (6.9%), acute kidney failure (5.5%), and urolithiasis (4.5%). Table 10 shows the total number and percentage of dogs affected by each reported kidney and/or bladder condition in descending order.

Table 10: Number and percentage of Boxers affected by each specific kidney and/or bladder condition, as reported in the survey

Specific condition	Number affected	Percentage
Urinary tract infection (UTI)	73	36.1%
Urinary incontinence	60	29.7%
Juvenile kidney disease (JKD)	14	6.9%
Acute kidney failure	11	5.5%
Urolithiasis	9	4.5%
Cystinuria	1	0.5%
Not known	6	3.0%
Other	28	13.9%
Total	**202**	

The most common answers to “other” for kidney and/or bladder conditions not already listed in the survey were: chronic kidney disease (n=3).

The median age that affected dogs were diagnosed with a kidney and/or bladder condition was 4 years. Figure 5 shows the total number of dogs affected by a kidney and/or bladder condition per year of age.

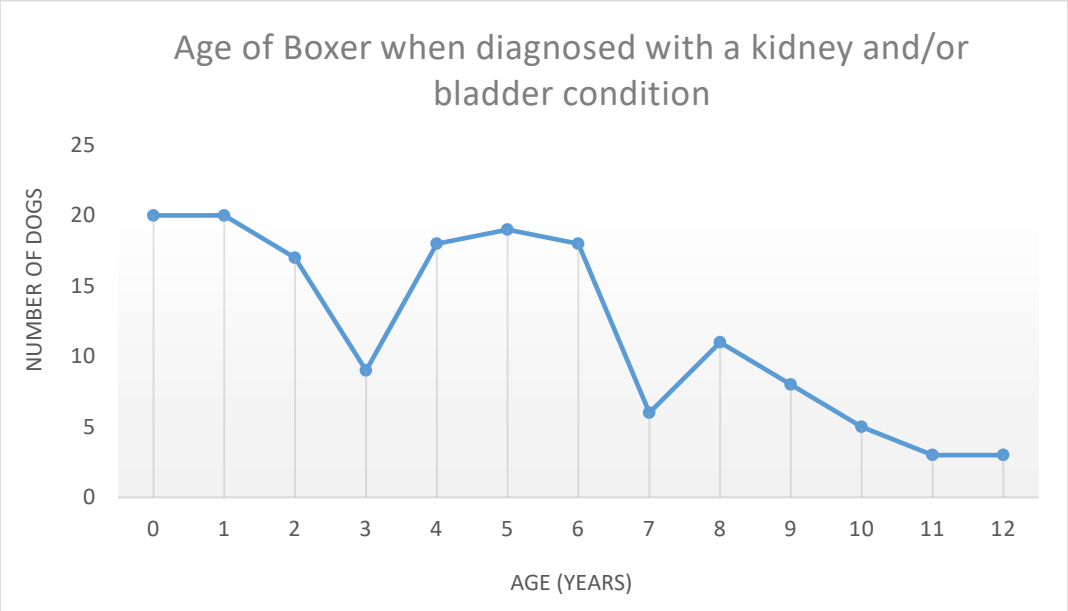

Figure 5: The age of Boxers when diagnosed with a kidney and/or bladder condition, as reported in the survey

Neurological Conditions

When asked if any of their dogs have suffered from a neurological condition(s), out of the 2,008 responses, 155 (7.7%) answered “Yes” and 1,853 (92.3%) answered “No”.

The total number of individual neurological conditions reported was 189. Of these, the most commonly reported condition was spondylosis deformans, which affected 30.7% of the study sample (58 of 189). This was followed by seizures (13.8%), idiopathic head tremor (8.5%), epilepsy - idiopathic (6.4%), and vestibular disease (5.3%). Table 11 shows the total number and percentage of dogs affected by each reported neurological condition in descending order.

Table 11: Number and percentage of Boxers affected by each specific neurological condition, as reported in the survey

Specific condition	Number affected	Percentage
Spondylosis deformans	58	30.7%
Seizures	26	13.8%
Idiopathic head tremor	16	8.5%
Epilepsy (idiopathic)	12	6.4%
Vestibular disease	10	5.3%
Steroid-responsive meningitis-arteritis (SRMA)	8	4.2%
Degenerative myelopathy (DM)	7	3.7%
Congenital deafness	3	1.6%
Epilepsy (cause known)	3	1.6%
Sensory neuropathy	1	0.5%
Not known	5	2.7%
Other	40	21.2%
Total	**189**	

The most common answers to “other” for neurological conditions not already listed in the survey were: stroke (n=4), tumour/cancer (n=4), and fused spine (n=4).

Reproductive Conditions

When asked if any of their dogs have suffered from a reproductive condition(s), out of the 2,001 responses, 107 (5.4%) answered “Yes” and 1,894 (94.7%) answered “No”.

The total number of individual reproductive conditions reported was 116. Of these, 43.1% were for male conditions (50 out of 116) and 56.0% were for female conditions (65 out of 116).

Overall the most commonly reported condition across sexes was cryptorchidism, which affected 34.5% of the study sample (40 of 116). This was followed by pseudopregnancy (24.1%), mastitis (10.3%), pyometra (9.5%) and follicular cysts (0.9%). Table 12 shows the total number and percentage of dogs affected by each reported reproductive condition.

Table 12: Number and percentage of Boxers affected by each specific reproductive condition, as reported in the survey

	Specific condition	Number affected
Male conditions	Cryptorchidism	40 (80.0%)
	Other	10 (20.0%)
	Total	**50**
Female conditions	Pseudopregnancy	28 (43.1%)
	Mastitis	12 (18.5%)
	Pyometra	11 (16.9%)
	Follicular cysts	1 (1.5%)
	Other	13 (20.0%)
	Total	**65**
Not known		1
Total		**116**

The most common answers to “other” for reproductive conditions not already listed in the survey were: infrequent seasons (n=3), and one testicle (n=2).

When asked if any of their dogs had ever been bred from, out of the 1,996 responses, 247 (12.4%) answered ‘Yes’ and 1,749 (87.6%) answered ‘No’. When asked if any of these dogs have ever had a caesarean section, out of the 246 responses, 80 (32.5%) answered ‘Yes’ and 166 (67.5%) answered ‘No’.

Table 13 shows whether the owner reported the caesarean section to be an elective or an emergency procedure. 16.1% (14 of 87) owners reported the caesarean section to be elective and 83.9% (73 of 87) owners reported the caesarean section to be an emergency.

Table 13: Shows whether the caesarean section was an elective or an emergency procedure *(C-section 1/C-section 2 refers to the first and second caesarean section performed on the same bitch)*

	Number affected (C-section 1)	Number affected (C-section 2)	Total
Elective	13	1	**14**
Emergency	70	3	**73**
Total	**83**	**4**	**87**

Out of 54 known reasons for caesarean section, uterine inertia was the most common (61.1%) following by dystocia (27.8%) then stillborn (11.1%), as shown in Table 14.

Table 14: Reasons for caesarean sections reported in the survey, and their numbers *(C-section 1/C-section 2 refers to the first and second caesarean section performed on the same bitch)*

Reasons	Number affected (C-section 1)	Number affected (C-section 2)	Total
Dystocia	13	2	**15**
Stillborn	5	1	**6**
Uterine inertia	33	0	**33**
Not known	9	0	**9**
Other	26	3	**29**
Total	**86**	**6**	**92**

The most common answers to “other” for reproductive conditions not already listed in the survey were: stuck puppy (n=5), exhaustion (n=2), twisted uterus (n=2), breeder decision (n=2), and large puppy (n=2).

Hormonal Conditions

When asked if any of their dogs have suffered from a hormonal condition(s), out of 2,040 responses, 107 (5.3%) answered “Yes” and 1,933 (94.8%) answered “No”.

The total number of individual hormonal conditions reported was 108. Of these, the most commonly reported condition was hypothyroidism, which affected 27.8% of the study sample (30 of 108). This was followed by hyperadrenocorticism (Cushing's disease) (6.5%), diabetes (0.9%), and hypoadrenocorticism (Addison's disease) (0.9%). Table 15 shows the total number and percentage of dogs affected by each reported hormonal condition in descending order.

Table 15: Number and percentage of Boxers affected by each specific hormonal condition, as reported in the survey

Specific condition	Number affected	Percentage
Hypothyroidism	30	27.8%
Hyperadrenocorticism (Cushing's disease)	7	6.5%
Diabetes	1	0.9%
Hypoadrenocorticism (Addison's disease)	1	0.9%
Not known	18	16.7%
Other	51	47.2%
Total	**108**	

The most common answers to “other” for hormonal conditions not already listed in the survey were: phantom pregnancy (n=21), and hair loss/alopecia (n=6).

Breathing Conditions

When asked if any of their dogs have suffered from a breathing condition(s), out of the 2,160 responses, 82 (3.8%) answered “Yes” and 2,078 (96.2%) answered “No”.

The total number of individual breathing conditions reported was 93. Of these, the most commonly reported condition was kennel cough, which affected 11.8% of the study sample (11 of 93). This was followed by upper respiratory tract problems

(10.8%), brachycephalic obstructive airway syndrome (BOAS) (8.6%), and elongated soft palate (7.5%).Table 16 shows the total number and percentage of dogs affected by each reported breathing condition in descending order.

Table 16: Number and percentage of Boxers affected by each specific breathing condition, as reported in the survey

Specific condition	Number affected	Percentage
Kennel cough	11	11.8%
Upper respiratory tract problems	10	10.8%
BOAS	8	8.6%
Elongated soft palate	7	7.5%
Chronic cough	4	4.3%
Stenotic nares	4	4.3%
Chronic rhinitis	3	3.2%
Tonsil problems	3	3.2%
Lung lobe torsion	1	1.1%
Not known	12	12.9%
Other	30	32.3%
Total	**93**	

The most common answers to “other” for breathing conditions not already listed in the survey were: panting during hot weather or exercise (n=7), lung tumour (n=3), pyothorax (n=2), pneumonia (n=2), shortness of breath (n=2) and cardiac issues causing breathing difficulties (n=2).

Dental Conditions

When asked if any of their dogs have suffered from a dental condition, out of the 1,959 responses, 259 (13.2%) answered “Yes” and 1,700 (86.8%) answered “No”.

When asked to specify the dental condition(s), the most common answers were: epulis (n=114), overgrown gums (n=29), lump/growth (n=20), tooth/teeth extraction (n=18), gums growing over teeth (n=15), broken tooth/teeth (n=9), gingival hyperplasia (n=8), bad breath (n=6), gingivitis (n=5), cyst (n=4), retained tooth/teeth (n=4), plaque (n=3), tumour/cancer (n=3), and grinding (n=3).

Haematological Conditions

When asked if any of their dogs have suffered from a haematological condition, out of the 1,959 responses, 12 (0.6%) answered “Yes” and 1,947 (99.4%) answered “No”.

The given answers were: anaemia (n=3), cancer (n=2), hemangiosarcoma (n=1), mild azotaemia (n=1), and low platelet level (n=1).

Hepatic Conditions

When asked if any of their dogs have suffered from a hepatic condition, out of the 1,959 responses, 8 (0.4%) answered “Yes” and 1,951 (99.6%) answered “No”.

The given answers were: liver disease (n=2), unable to diagnose (n=2), tumour (n=1), and inflammation (n=1).

Additional Conditions not listed in survey

The respondents were provided with the opportunity to note any conditions not already covered by the previous questions. These are given in the Appendix on page 51.

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.

Cardiovascular conditions

Aortic stenosis/subaortic stenosis (SAS): In a French study of Boxers which underwent echocardiography at the Cardiology Unit of Alfort University, between January 1998 and May 2005, 105 dogs were diagnosed with one or more congenital heart disease. In total, 46.7% (49 cases) of Boxers with congenital heart disease were found to have subaortic stenosis (Chetboul et al, 2006b). An Italian study of mandatory breed screening results between 1999 and 2004 reported a SAS prevalence of 8.5% (109 of 1283 dogs) (Bussadori et al, 2009). A more recent study of electronic patient records of 90,004 dogs examined at the University of California-Davis Veterinary Medical Teaching Hospital, USA, between 1st January 1995 to 1st January 2010 found the Boxer to be the third most frequently affected breed with aortic stenosis, with a breed-specific prevalence of 4.49% compared to a mixed breed-prevalence of 0.15% (Bellumori et al, 2013).

Arrhythmogenic right ventricular cardiomyopathy (ARVC): This condition was first given this name (which it shares with a human condition) in a study of 239 Boxers with ventricular arrhythmias, including six large families, at Ohio State University, although the breed had long been noted to be predisposed (Basso et al, 2004). Affected dogs present with clinical signs such as fainting (syncope), fast abnormal rhythms (tachyarrhythmias) and sudden death, but can also live with stable disease. In affected dogs the median age of diagnosis is six years (range one to 11) with a median survival age of 11 years (Meurs et al, 2014). Pedigree analysis of UK cases and unaffected dogs, using Kennel Club records, suggest that the disease in the UK originates from a small number of Boxers imported from the USA (Cattanach et al, 2015). It is suggested to have a single gene autosomal dominant mode of inheritance, with low penetrance. Whilst there has been speculation of the

involvement of *STRN,* as it stands it appears this is not the causative mutation for the condition in the breed but may sit closely to the true mutation (Sargan, 2015; Cattanach et al, 2015).

Atrial septal defect (ASD): This congenital heart defect involves a 'hole' in the wall separating the top two chambers of the heart, allowing oxygen-rich blood to leak into the oxygen-poor blood chambers in the heart. The Boxer predominated in a French study of cases of the condition at the Cardiology Unit of Alfort University between January 2001 and March 2005, representing 31.9% (36 of 113 dogs) of cases (Chetboul et al, 2006a). The breed had an odds ratio of 15.28 (95% C.I. 10.24 – 22.84; 36 cases out of 912 dogs admitted to the hospital over that time period) of being diagnosed with the condition compared to dogs of other breeds.

Dilated cardiomyopathy (DCM): This condition is noted as a breed predisposition (Gough, Thomas and O'Neill, 2018), but is considered to be less common in the Boxer than ARVC. A mutation in the striatin gene has been found to be associated with the phenotype in the breed, but is not found in all affected Boxers (Meurs et al, 2001; Meurs et al, 2013).

Mitral valve dysplasia (MVD): MVD was the second most commonly diagnosed condition in a French study of 105 Boxers with congenital heart disease at the Cardiology Unit of Alfort University, between January 1998 and May 2005. In total, 55.2% (58 cases) of Boxers with congenital heart disease were found to have MVD (Chetboul et al, 2006b).

Pulmonic stenosis: This condition was the fourth most commonly diagnosed condition in a French study of 105 Boxers with congenital heart disease at the Cardiology Unit of Alfort University, between January 1998 and May 2005. Some 4.8% (five cases) of Boxers with congenital heart disease were found to have MVD (Chetboul et al, 2006b).

Dermatological conditions

Atopic dermatitis (atopy): A Swedish study investigating the prevalence of atopic dermatitis in an insured population reported the Boxer as the third most frequently diagnosed breed with the condition, with 53 claims for the condition out of a total of 1,584 Boxers. The breed had an incidence of 8.4 cases per 1000 dog years at risk (DYAR), compared to an overall incidence rate of 1.7 cases per 1000 DYAR (Nødtvedt et al, 2006).

Calcinosis circumscripta: This involves the deposition of inorganic, insoluble calcium salts in the skin. A study of cases seen at the University of California Davis, USA, found that five of 46 cases (10.8%) were in Boxers or Boxer crosses, which was more than would be expected from the overall hospital population (Doerr et al, 2013).

Canine follicular dysplasia (seasonal flank alopecia): This condition involves bilaterally symmetric alopecia and hyperpigmentation, especially over the flanks, and is generally seasonal and recurrent. The cause is unknown in the breed, but it is presumed to have a genetic basis as it is seen so frequently in the Boxer according

to North American authors (Rachid et al, 2003). No prevalence estimates could be found in the literature.

Demodicosis (Demodectic mange): A study of 499 dermatology cases between 1998 and 2006 at the Small Animal Hospital in Buenos Aires, Argentina, included 28 cases of juvenile generalised demodicosis. Seven cases were seen in Boxers, and the breed had an odds ratio of 7.52 (95% C.I. 2.86 - 19.74; 7 cases and 20 non-cases) compared to dogs of other breeds suggesting the breed may be at increased risk of the condition. 5

Endocrine conditions

Hyperadrenocorticism (Cushing's disease): The Boxer has been reported to be increased risk of this endocrinopathy (Gough, Thomas and O'Neill, 2018). In a study of 85 dogs with the pituitary dependent form of the condition, admitted to the University of Bologna, Italy, between 2003 and 2013, the Boxer was the second most commonly diagnosed breed with the condition (Fracassi et al, 2014). Nine cases (10.65) in the study were Boxers, but the general population of the breed was unknown so the prevalence of the condition in the breed could not be estimated. No further papers could be found in support of this condition in the breed.

Gastrointestinal conditions

Cleft palate: A birth cohort of 2,629 Boxers in the Netherlands had a prevalence of cleft palate of 2.3% (61 cases and 2,561 non-cases), with a probable autosomal recessive mode of inheritance (Nielen, et al, 2001). No further or more recent research could be found for this condition in the breed.

Histiocytic ulcerative colitis/ granulomatous colitis: This condition, causing severe large bowel diarrhoea, is considered almost unique to the Boxer. It was first reported in 1965 in a number of Boxers from a kennel in Northern America, and cases have since been reported in dogs of the breed in many countries including the UK (Churcher and Watson, 1997). Prevalence estimates could not be sourced, but the Boxer is mentioned as a predisposed breed in a number of studies (Dogan et al, 2020; Manchester et al, 2021; Manchester et al, 2013).

Haematological conditions

Haemophilia A (Factor VIII deficiency): The breed has been reported to at risk of a severe, familial form of this inherited clotting disorder (Brooks, 1999); however, no prevalence estimates were provided. Subsequently a single mutation has been found in Factor VIII, which is involved in the regulation of blood clotting, and proposed as inherited in an x-linked pattern (Christopherson et al, 2014).

Immunological conditions

Non-infectious inflammatory myopathy: A recent paper assessed the clinical characteristics of American Boxers affected with this condition that were submitted to a University between 2010 and 2018 (Hong et al, 2021). A total of 28 dogs were presented, of which 18 were males and 10 females, with a median age of 6 years (range one year to 11). The most commonly reported clinical signs included general

weakness/ exercise intolerance (60.7%), problems eating (39.3%), weight loss (35.7%), stiff-stilted gait (32.1%), lethargy (32.1%) and muscle wasting (14.3%). Creatinine kinase (an enzyme involved in muscle breakdown/ wastage) levels were elevated in all dogs tested (n=20). Despite treatment, prognosis was poor with 70% of those available for follow-up (n=24) either being euthanised, dead or undergoing relapse. The authors noted a potential association between disease and cancer but did not have enough clinical data to confirm this.

Musculoskeletal conditions

Cranial cruciate ligament rupture (CCLR): The Boxer was reported to be at increased risk of cranial cruciate ligament disease, with an odds ratio of 2.14 (95% C.I. 2.00 – 2.30; 836 cases out of 15,962 Boxers) compared to dogs of all breeds, based on dogs which had attended veterinary teaching hospitals in the USA between 1964 and 2003 (Witsberger et al, 2008). A later paper assessed the degree of osteoarthritis in 240 dogs affected with cruciate ligament injury, and determined that the 51 Boxers included had a higher degree of stifle osteoarthritis compared to the other breeds included (Gilbert et al, 2018). For the breed the mean age was 5.6 ± 2.4 years, and mean weight of 32.2kg ± 7.3kg. Similarly, dogs weighing over 35kg across all breeds were determined to have a higher osteoarthritis score.

Diffuse idiopathic skeletal hyperostosis (DISH): This condition affects the entire skeleton and results in ossification of soft tissues, including spinal ligaments and sites of attachment of tendons to bone, resulting in stiffness and pain. A retrospective radiographic study of dogs over than one year of age referred to the Utrecht University Veterinary Medical Teaching Hospital between 2003 and 2008 revealed an overall prevalence of DISH of 3.8% (78 cases in 2041 dogs). The prevalence of DISH in Boxers was 40.6% (28 cases in 69 dogs of the breed), and the breed had an odds ratio of 51.3 for developing the condition compared to dogs of other breeds (Kranenburg et al, 2011)

Hip and elbow dysplasia: In a study of 4,725 Boxers in Italy, the prevalence of hip dysplasia was estimated as 25.2%, and the heritability of the condition was estimated as 0.24±0.047 (Sturaro et al, 2006). UK hip dysplasia data are discussed in the Canine Health Schemes section later in this document.

Metaphyseal osteopathy (hypertrophic osteodystrophy): The Boxer was reported to be at elevated risk of this condition, with a breed-associated odds ratio compared to mixed breeds of 18.4 (95% C.I. 7.1 – 47.5), based on dogs which had attended veterinary teaching hospitals in the USA; however, this result was based on just seven cases and seven non-cases in the breed (LaFond et al, 2002).

Osteochondrosis dissecans (OCD): The Boxer was over-represented in a UK case study of 34 cases of OCD of the lumbosacrum, representing 11% (four dogs) of cases (Hanna, 2001). No more recent studies or prevalence estimates could be found in the literature. The breed was reported to be at elevated risk of OCD of the shoulder, with a breed-associated odds ratio compared to mixed breeds of 2.2 (95% C.I. 1.1 – 4.5), based on dogs which had attended veterinary teaching hospitals in the USA; however this result was based on just nine cases and 67 non-cases in the

breed (LaFond et al, 2002). Similarly, the paper above also reported the Boxer to be at elevated risk of OCD of the stifle, with a breed-associated odds ratio compared to mixed breeds of 56.3 (95% C.I. 24.8 – 127.8), based on dogs which had attended veterinary teaching hospitals in the USA; however this result was based on just 14 cases and 11 non-cases in the breed.

Panosteitis: The Boxer was reported to be at elevated risk of panosteitis, with a breed-associated odds ratio compared to mixed breeds of 1.8 (95% C.I. 1.4 – 2.3), based on dogs which had attended veterinary teaching hospitals in the USA; this result was based on 90 cases and 340 non-cases in the breed (LaFond et al, 2002).

Spondylosis deformans: This degenerative spinal disease is often clinically insignificant, but severe forms cause stiffness, lameness and pain. A radiographic screening study of 851 Boxer dogs in Italy between 1997 and 2001, with a mean age of 20 months (range 10 to 84 months), reported that 84% of dogs had spondylosis lesions (Carnier et al, 2004). A more recent study undertaken in the Netherlands (referenced above under DISH) found a prevalence of 55.1% (of 69 Boxers) for spondylosis, as well as 40.6% for diffuses idiopathic skeletal hyperostosis (DISH), with the diseases showing high concurrence (Kranenburg et al, 2011). The authors noted an odds ratio of 9.2 (95% CI not provided) for spondylosis.

Neoplastic conditions

Brain tumours: A retrospective American study of 9,574 post-mortem examinations undertaken at a veterinary university found the Boxer had an apparent increased risk of primary intracranial neoplasms with a breed-specific prevalence of 13.3% (28 cases in 212 dogs of the breed) compared to an overall prevalence of 2.3% (227 cases in 9,574 dogs of all breeds) (Song et al, 2013). More recently a Japanese study identified the breed as predisposed to intracranial gliomas, cancers that form within the tissue of the central nervous system, with an odds ratio of 16.4 (95% CI 2.1-127.1) (Kishimoto et al, 2019). It should be noted however that there was just one affected dog of the breed out of a total sample of 19. Intracranial tumours have been suggested to be more common in brachycephalic dogs and predispositions have been mentioned in a number of brachycephalic breeds (Miller et al, 2019).

Cutaneous tumours: A survey of veterinary surgeons who had submitted samples for histopathological analysis in the UK found that the Boxer was the sixth most commonly affected breed with cutaneous histiocytoma, a benign skin tumour, representing 7.4% (18 of 242) of cases (Killick et al, 2011). Similarly the breed has been estimated to have an incidence rate of 1,350 per 100,000 dog years, based on 415 cutaneous tumours submitted to a Swiss canine cancer registry (Graf et al, 2018). The breed was also suggested to have a high incidence rate of mast cell tumours, histiocytomas, soft tissue sarcomas and vascular tumours.

Dermoid cyst: A study undertaken by the Royal Veterinary College (RVC) assessed 2,554 submissions of skin masses from dogs aged under 12 months to determine the incidence and type of masses affecting different breeds (Kim et al, 2021). The Boxer made up 6.74% of masses and was the most commonly represented breed for dermoid and follicular cysts (making up 25.9% of 85 and 25.0% of 44 cysts

respectively), but interestingly was proposed as having a reduced odds for histiocytoma (referenced above) at 0.38 (95% CI 0.23-0.62). Whilst the Boxer was suggested as being predisposed to dermoid and follicular cysts, this was not supported statistically.

Fibroadnexal hamartoma: These benign tumours involve hair follicles and glandular structures. A study of 5,864 pathology samples submitted to two diagnostic services in Brazil between 2001 and 2008 included 53 cases of fibroadnexal hamartoma. The Boxer was the most frequently affected breed, with six cases (11.3%) in the breed (Loures and Conceição, 2009) suggesting the breed may be at increased risk of the condition.

Lymphoma: The Boxer was reported to be at increased risk of lymphoma based on UK insurance data; there were 103 cases of the condition out of 130,684 insured dogs, and 10 cases out of 5,628 insured Boxers (Edwards et al, 2003). The breed had an odds ratio of 3.26 (95% C.I. 1.57 – 6.76) compared to dogs of other breeds. The Boxer appears to develop a specific type of cancer, T-cell lymphoma, more frequently than other breeds, with a study suggesting an odds ratio of 2.56 for non-specific lymphoma in the UK (CI not provided) and 10.9 (95% CI 5.36-22.3) for high grade T-cell lymphoma (Comazzi et al, 2018). Similarly, it appears the breed may have a lower survival time than other breeds, with an American study finding a median survival of 178 days for Boxers, versus 423 days for remaining breeds (Rout et al, 2020). A Hungarian paper also suggested the breed may not respond to chemotherapies as well as other breeds, however the full paper could not be accessed (Jankowska et al, 2019).

Possible influencing factors have been proposed in terms of the risk of developing lymphoma, with this including proximity to environmental toxins and chemicals (Smith et al, 2021; Craun et al, 2020), biological processes such as ageing and oestrogen deficiency (Rzechorzek et al, 2019), as well as a genetic basis (Comazzi et al, 2018). The breadth and variation of these studies indicate the complex basis of disease in not only the Boxer, but all breeds affected.

Mammary tumours: Analysis of Swedish Agria insurance data, considering female dogs enrolled for both veterinary care and life insurance during 1995 to 2006, estimated the disease incidence of pyometra in 260,000 female dogs. Each full year a dog was insured contributed to one dog-year at risk (DYAR). The overall incidence rate for mammary tumours was 112 cases per 10,000 DYAR (95% C.I. 110-114). The prevalence of mammary tumours in Boxer bitches in this study was 35.0% (236 cases in 2,198 bitches), ranking the breed seventh out of 110 breeds in terms of breed-specific prevalence (Jitpean et al, 2012).

Mast cell tumour (MCT): In a study of dogs treated for MCTs at the University Veterinary Centre, Sydney, Australia between 1989 and 2001, the Boxer represented 21.4% (12 of 56 cases) of cases suggesting a possible breed predisposition (Baker-Gabb et al, 2003). A recent VetCompass study is also available below. There have been several papers that suggest the breed is more likely to develop the low risk MCT compared to high risk (Smiech et al, 2018; Smiech et al, 2019; Pierini et al, 2019).

Osteosarcoma: The breed was found to be at increased risk of malignant bone tumours in a study of Swedish Agria insurance data, with an overall incidence of 13 cases (95% C.I. 7 - 19) per 10,000 DYAR compared to the risk in all breeds combined of 5.5 cases per 10,000 DYAR (Egenvall et al, 2007). However no further papers could be found that supported an increased risk in the breed for this cancer.

Vascular tumours: The Boxer was reported to be at increased risk of vascular tumours in a Norwegian study, with an annual incidence rate of 1.5 cases per 1000 dogs of the breed (Moe et al, 2008). This was the highest incidence rate of all breeds. A recent Italian study suggested a possible predisposition in the Boxer to perivascular wall tumours, or soft tissue cancers that form within the vessels of an affected individual (Chiti et al, 2020). However, it should be noted that following multivariate analysis (including all possible risk factors for disease, such as age, grade of cancer etc.) this association with breed was no longer significant. Following 102 dogs of different breeds affected with this cancer the median survival time was 1,125 days, with survival at 82% one year on from diagnosis, falling to 51% at three years.

Neurological conditions

Degenerative myelopathy (DM): DM is a progressive neurodegenerative condition in dogs, with clinical signs usually not manifesting until eight years of age or older. Affected dogs initially show signs of ataxia of the pelvic limbs and a definitive diagnosis can only be by made post mortem. A mutation associated with the condition was first described in 2009; a missense mutation in the *SOD1* gene on chromosome 31, with homozygosity for the A allele being strongly associated with the DM phenotype (Awano et al, 2009). The mutation appears to be autosomal recessive with incomplete penetrance, suggesting the involvement of modifier loci and/ or environmental factors, and has been found to be widespread and common in many breeds. In all 33,746 DNA samples submitted to the University of Missouri up to 2013, the mutation was reported to have an allele frequency of 72% in the Boxer (Zeng et al, 2014).

Discospondylitis: Infection of the cartilaginous vertebral endplates of the spine with secondary involvement of the intervertebral disc is termed discospondylitis. A study of 513 dogs with the condition from 12 veterinary teaching hospitals in the USA, and 236,109 dogs without the condition (controls), reported that the Boxer was at increased risk of discospondylitis, with an odds ratio of 3.5 (95% C.I. 1.8 – 6.9; 10 cases, 1,017 controls) compared to mixed-breed dogs (Burkert et al, 2005). 10

Epilepsy: A birth cohort of 2,629 Boxers in the Netherlands had a prevalence of epilepsy of 2.4% (49 cases and 1,984 non-cases) (Nielen, et al, 2001). In a subsequent study of 655,249 Swedish dogs insured with Agria between 1995 and 2006, the Boxer had the highest incidence rate of epilepsy at 60.3 cases per 10,000 DYAR (95% C.I. 49.3 – 71.3; 115 cases in 19,070 DYAR for the breed) compared to an overall incidence rate of 18 cases per 10,000 DYAR (Heske et al, 2014). The Boxer also appeared to be at increased risk of mortality due to the condition, with a mortality rate of 46.7 deaths per 10,000 DYAR (955 C.I. 35.8 – 57.7; 70 deaths in

14,979 DYAR for the breed) compared to an overall incidence rate of 11 deaths per 10,000 DYAR.

Idiopathic head tremor syndrome: The Boxer was the second most frequently affected breed, representing 13% of cases (37 of 291 dogs), in a multinational survey of veterinary surgeons (Shell et al, 2015). However, no other papers could be found in respect to this condition in the breed.

Steroid-responsive meningitis-arteritis (SRMA): SRMA is an immune driven disease which affected dogs presenting with inflammation within the meninges (membrane which covers the brain and central nervous system), with clinical signs including fever, altered perception to touch, lethargy, pain and in severe cases, death. A study of dogs with the acute form of SRMA presented to Langford Veterinary Services between 2003 and 2012 reported that the Boxer was at increased risk of developing this condition, with an odds ratio of 4.60 (95% C.I. 1.20-17.67) compared to dogs of other breeds (Rose et al, 2014). This result was based on just four cases and six non-cases in the breed, however the breed has been noted as being over-represented in more recent studies (Lau et al, 2019). Affected dogs are relatively young, with a median age of 8.5 months (95% in the aforementioned study being under two years of age). Relapse is common, with between 29% to 49% showing repeat clinical signs in the more recent studies (Lau et al, 2019; Hilpert et al, 2020).

Ocular conditions

Superficial chronic corneal epithelial defects (SCCED): This condition has been detailed in the breed relatively recently and are characterised as persistent corneal ulcers with no known underlying cause. Several papers note the breed as over-represented (Hung et al, 2020; Boutin et al, 2020) with the breed making up 26.3%-30.2% of the study population. Affected dogs present later in life, with a median age of eight to nine years, based on the studies mentioned above. In 2021 an American study was undertaken to attempt to determine the genetic basis for disease, with a mutation in *NOG* identified as a possible causative factor (Meurs et al, 2021). Further work is needed to confirm this association with clinical disease.

Reproductive conditions

Cryptorchidism: A birth cohort of 2,629 Boxers in the Netherlands had a prevalence of cryptorchidism of 10.7% (80 cases and 667 non-cases in the males), with a heritability estimate of 0.23 (Nielen et al, 2001). No other papers could be sourced that supported the breed being predisposed to this condition.

Dystocia: A survey of Boxer breeders in Sweden between 1994 and 1997 included data from 253 whelpings, constituting 56.5% of all Boxer litters registered with the Swedish Kennel Club during this time. Dystocia occurred in 32.0% of bitches and in 27.7% of whelpings (Linde Forsberg and Persson, 2007). A further VetCompass paper detailing predisposition in the breed is detailed below.

Pyometra: The prevalence of pyometra in different breeds was assessed through patient admittance to RSPCA animal hospitals between 2006 and 2011 (Gibson et al., 2013). The Boxer was the tenth most frequent breed affected, with a prevalence

of 2.7% compared to an all-breed prevalence of 2.2%. Numbers of affected and unaffected bitches of the breed were not reported and no further papers could be sourced that support the breed being over-represented for this disease.

Urological conditions

Renal glomerular immaturity/ maldevelopment/ dysplasia/ juvenile-onset chronic kidney disease (JOCKD): A recent study noted the presence of immature glomeruli (vessels that play a role in cleaning blood within the kidney) in nine young Italian Boxers presenting with clinical signs of kidney disease, including excessive urination and thirst (polyuria and polydipsia), anorexia, weight loss, stunted growth, lethargy and weakness (Cavalera et al, 2021). Prognosis was poor, with all nine ultimately euthanised due to severe disease. The authors proposed an autosomal recessive mode of inheritance based on the pedigree data for seven of the included dogs and suggested that dogs with a family of CKD should be screened prior to breeding. Juvenile nephropathy has also been reported in the past for the breed, with another case series of 37 dogs of breed diagnosed with the condition in the UK (Chandler et al, 2007). In this study females were the predominant sex (78.4% of all dogs).

A recent study of Swedish insurance claim records from 1995-2006 reported an overall incidence of kidney disease of 15.8 (95% C.I. 15.3-16.2) cases per 10,000 dog years at risk (DYAR) for a population of 665,245 dogs; for Boxers the kidney disease incidence was 36 (95% C.I. 27 - 44) cases per 10,000 DYAR, based on 69 cases in 19,190 DYAR, suggesting that the breed is at increased risk of kidney disease compared with dogs of other breeds. Considering 548,346 life insurance policies, the total kidney-related mortality was 9.7 (95% C.I. 9.3-10.2) deaths per 10,000 DYAR; for Boxers the kidney-related mortality was 23 (95% C.I. 16 - 31) per 10,000 DYAR, based on 35 deaths in 14,914 DYAR, suggesting the breed is also at increased risk of mortality due to kidney disease compared to dogs of other breeds (Pelander et al, 2015).

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 Boxer, the breed is included in the condition-specific studies detailed below.

Whilst a breed-specific VetCompass study has not yet been completed, some condition-specific studies have yielded findings relevant to the Boxer. These results are summarised under the respective conditions below.

Dermatological conditions

Juvenile-onset demodicosis: A paper determining breed-prevalence and predisposition highlighted the Boxer as having increased odds of juvenile demodicosis, with a prevalence of 0.41% and odds ratio of 2.04 (95% CI 1.03-4.04, p=0.04) (O'Neill et al, 2020). The breed as a whole (including dogs over the age of two) also had increased odds, at 3.90 (95% CI 1.28-11.86).

Gastrointestinal conditions

Inflammatory bowel disease (IBD): The Boxer is considered particularly susceptible to IBD. In a study of 546 dogs diagnosed with IBD at the Royal Veterinary College between August 2003 and December 2009, the Boxer was at increased odds of being diagnosed with the condition compared to mixed-breed dogs with an odds ratio of 1.70 (95% C.I. 1.04 - 2.76) based on 31 cases and 1,219 non-cases in the breed (Kathrani et al 2011).

Neoplastic conditions

Mast cell tumour (MCT): A recent study assessing the prevalence and risk factors for MCTs in UK based dogs found the Boxer to be at increased odds of MCTs compared to crossbreed dogs (Shoop et al, 2015). The study used VetCompass data consisting of 168,636 dogs attending 94 veterinary practices in England between 2007 and 2013, of which 453 dogs met the case inclusion criteria. Overall MCT prevalence was estimated at 0.27%. The Boxer was one of the breeds that exceeded this with MCT prevalence of 1.95% (95% C.I. 1.40% - 2.51%). The breed was reported to have an odds ratio of 12.9 (95% C.I. 7.3 - 22.7) compared to dogs of no recognisable breed.

Ocular conditions

Corneal ulceration: In a VetCompass study of 104,233 dogs attending 110 first opinion veterinary practices in England, the Boxer had a breed-specific prevalence of 4.98% (69 cases out of 1386 dogs of the breed) compared to an all-breed prevalence of 0.80% (O'Neill et al, 2017). The Boxer had an odds ratio for corneal ulceration of 13.84 (95% C.I. 10.05 – 19.06) compared with dogs of no recognisable breed.

Reproductive conditions

Dystocia: In a recent VetCompass study of 50 first-opinion emergency-care veterinary practices, the Boxer had a dystocia prevalence of 3.3% based on 12 cases and 355 non-cases, giving an odds ratio of 2.5 (95% C.I. 1.3 to 4.8) compared to dogs of no recognisable breed (O'Neill et al, 2017b).

Renal conditions

Urethral sphincter mechanism incompetence: A VetCompass study of 100,397 bitches attending 119 veterinary clinics between 1st September 2009 and 7th July 2013 reported that the Boxer had a prevalence of 7.3% (95% C.I.5.9 – 8.8) for

urinary incontinence, compared to an all-breed prevalence of 3.14% (95% C.I. 2.97 - 3.33). The Boxer had an odds ratio for urinary incontinence of 2.31 (95% C.I. 1.50 – 3.55; 24 cases and 1,272 non-cases) compared with dogs of no recognisable breed (O'Neill et al, 2017c).

Urinary incontinence: A VetCompass study of 190,428 male dogs submitted to general practice estimated 1,027 with urinary incontinence, with a prevalence of 0.94% (95% CI 0.88-1.00) (Hall et al, 2019). The Boxer was found to be one of the breeds with the highest odds, with this being 3.65 (95% CI 1.84-7.25) and a breed prevalence of 2.49% (95% CI 1.77-3.40%).

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.

Insurance data were available for Boxers insured with Agria UK. 'Exposures' are equivalent to one full policy year; in 2017 these figures were 2,667 free exposures, 1,086 full exposures and 1,910 claims and for 2018 these figures were 233, 900 and 1743 respectively. Full policies are available to dogs of any age. Free policies are available to breeders of Kennel Club registered puppies and cover starts from the time the puppy is collected by the new owner; cover under free policies lasts for five weeks from this time. It is possible that one dog could have more than one settlement for a condition within the 12-month period shown. The top 10 conditions by number of settlements, for authorised claims where treatments started between 1st July 2017 and 31st June 2018, are shown in Table 17 below.

Table 17: Top 10 conditions and number of settlements for each condition between 1st July 2017 and 31st June 2018 for Boxers insured with Agria UK.

Condition	Number of settlements
Hypersensitivity (allergic) skin disorder (unspecified)	183
Atopy finding	78
Pruritis finding	66
Renal (kidney) disorder	58
Ulcerative keratitis (Corneal ulceration)(unspecified)	55
Lameness finding	51
Cruciate ligament rupture - caudal and cranial	48
Osteoarthritis (osteoarthrosis degenerative joint disease (DJD))(unspecified)	46
Diarrhoea - presumed self-limiting	44
Spondylosis (unspecified)	40

[$] N.B. - Allergy is any exaggerated immune response to a foreign antigen regardless of mechanism. A dog can be allergic without being atopic. Atopy is a genetic predisposition to an exaggerated Immunoglobulin E (IgE)-mediated immune response to allergens in the environment. The treatment of atopy will be different to the treatment of non-atopic allergy.

Swedish Agria Data

Swedish morbidity insurance data were available from Agria for the Boxer. 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. one DYAR is equivalent to one whole year of insurance. The number of DYAR for Boxer in Sweden during this period was between 5,000 and 10,000. A summary is given below, with the full analysis available from: https://dogwellnet.com

Swedish Agria insurance morbidity data

Specific causes for veterinary care episodes

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Boxer in Sweden between 2011 and 2016 are shown in Figure 6. The top five specific causes of VCEs were vomiting/ diarrhoea/ gastroenteritis, skin tumour, epulis, locomotory pain, and dermatitis/ pyoderma/ folliculitis.

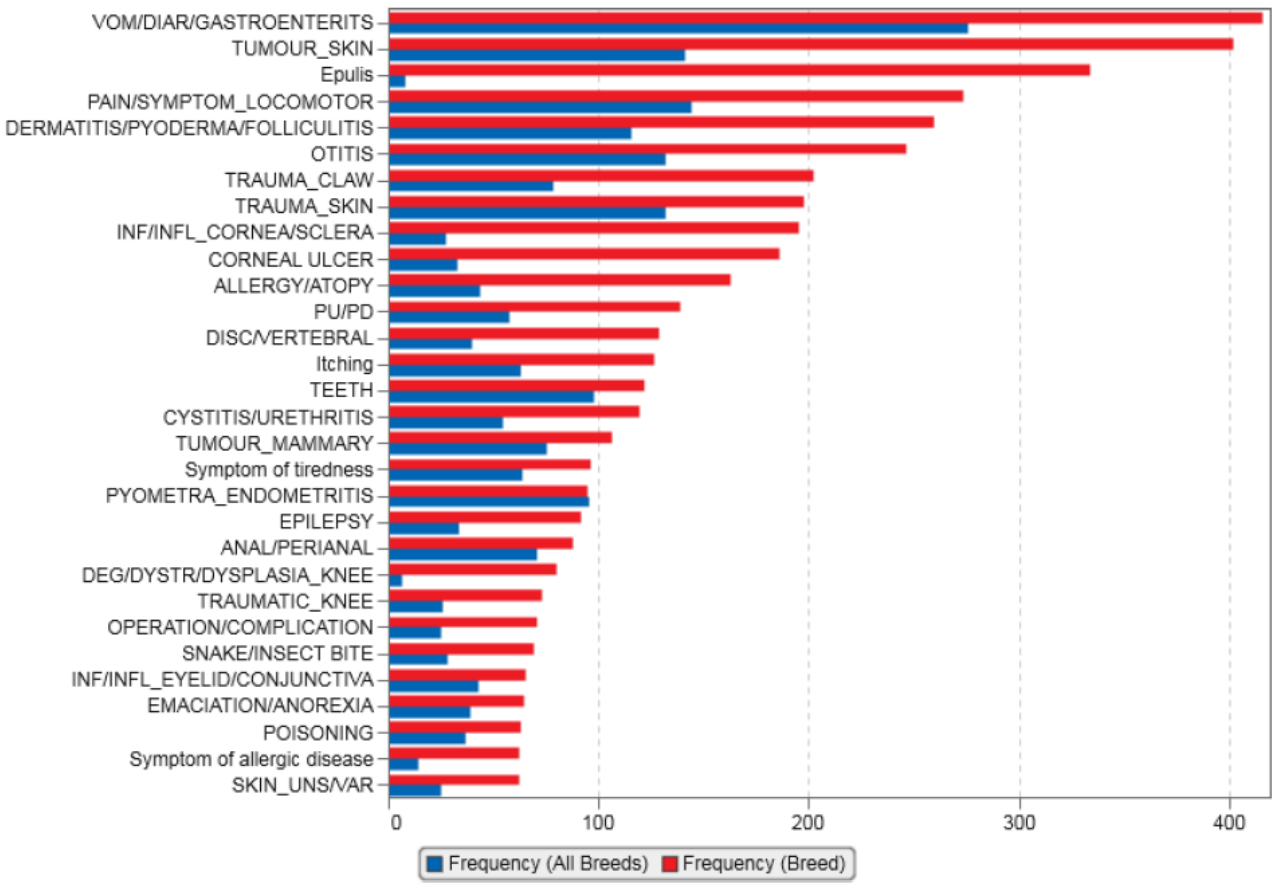

Figure 6: The most common specific causes of VCEs for the Boxer compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

Relative risk for veterinary care episodes

The specific causes of VCEs ordered by relative risk are shown in Figure 7 for the Boxer. In this analysis, the top five specific causes of VCEs ordered by relative risk were epulis, heart vessel defect, degeneration/ dystrophy/ dysplasia of the knee, infection/ inflammation of the central nervous system, and infection/ inflammation of the cornea/ sclera.

It is important to note that with relative risk analysis some rarer conditions may appear as a higher relative risk and so should be interpreted cautiously.

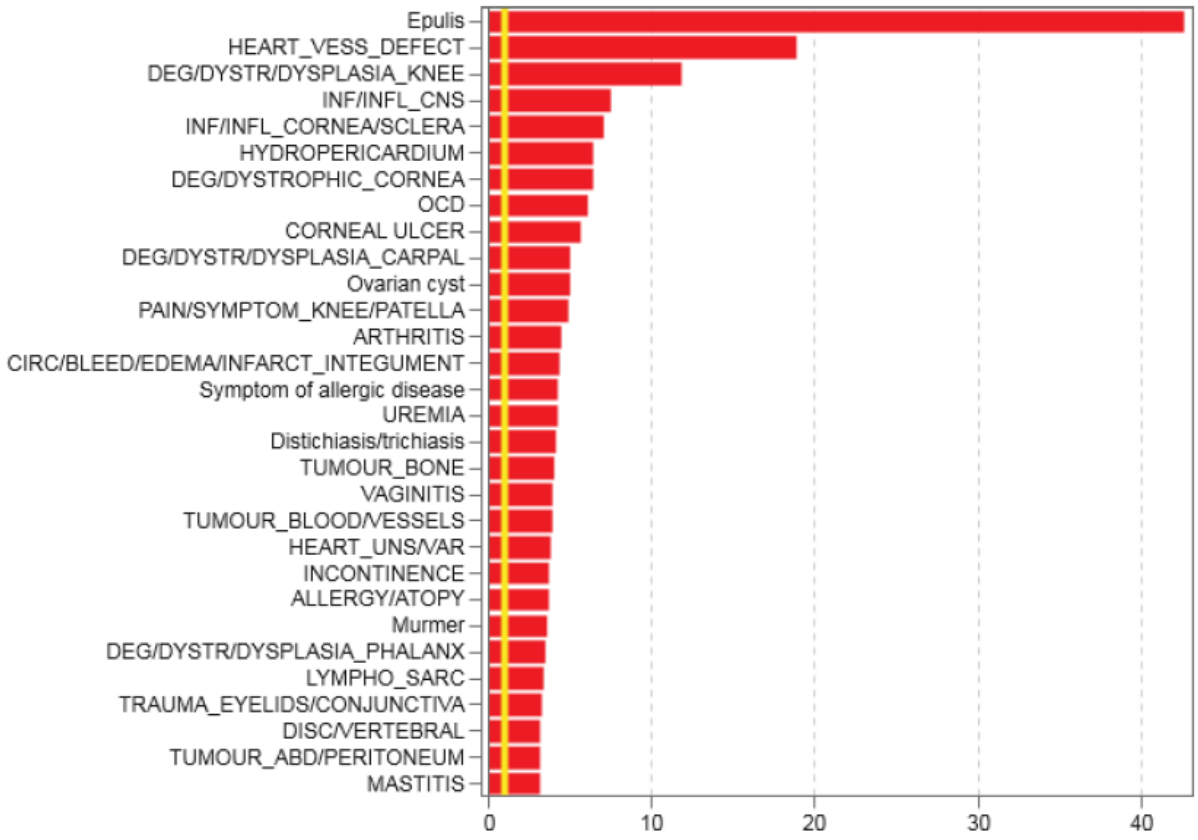

Figure 7: The specific causes of VCEs for the Boxer ordered by relative risk compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

In terms of mortality and most commonly reported causes of death, these data are shown in Figure 8, with the top causes being dead/ euthanised, epilepsy, disc/ vertebral disorder, knee trauma and lymphosarcoma.

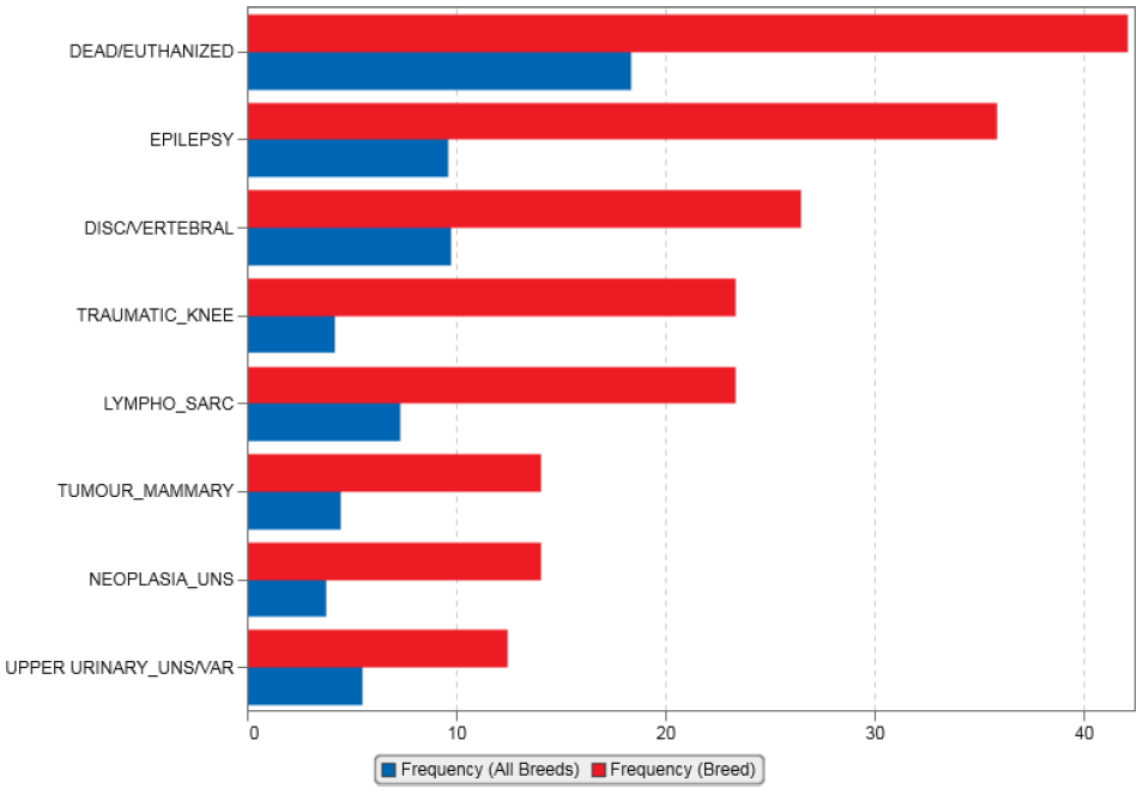

Figure 8: The most common specific causes of death for the Boxer compared to all breeds in Sweden between 2011 and 2016, from Swedish Agria insurance data.

BREED WATCH

The Boxer is a category two breed, meaning judges are required to complete mandatory monitoring forms following an appointment as championship certificate level. The addition of the below point of concern “pinched nostrils” was added relatively recently, and due to the COVID19 pandemic and subsequent lockdown little data have been collected to date. A further breakdown of reports will be provided when championship shows are back to usual routine.

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, 18 reports have been received for the Boxer (excluding neutering or caesarean sections), which are shown in Table 18 below.

Table 18: Permission to show reports received for the Boxer between 2015 and 2020.

Surgery	Year					
	2015	2016	2017	2018	2019	2020
Mastectomy		1				
Osteochondritis dissecans (OCD)				1		
Removal of dermoid cyst		2				
Removal of a mass					1	
Removal of cysts			1		1	1
Removal of Lumps/masses/tumours/ cysts		1				
Tail amputated due to trauma	2	1	1	1	1	
Tail partially amputated					1	
To have the working dog's tail legally docked		1	1			

ASSURED BREEDERS SCHEME

It is currently recommended that Assured Breeders:

- Hip score under the British Veterinary Association (BVA)/Kennel Club (KC) Hip Dysplasia Scheme
- Heart tested through the breed club's scheme (aortic stenosis)

BREED CLUB BREEDING RECOMMENDATIONS

Breed Club heart testing for aortic stenosis is strongly recommended for Boxers which are to be used for breeding.

DNA TEST RESULTS

There are currently no recognised DNA test for this breed.

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.

HIPS

To date (Sept 2021), 356 Boxers have been hip scored under the BVA/KC Hip Dysplasia Scheme, with a 15-year median hip score of 13 and 5-year score of 12.

Whilst this shows an improvement in overall score it is worth mentioning that the proportion of dogs born that are them tested is low, with just one dog born in 2019 having been tested so far (Figure 9). The graph shows a huge degree of fluctuation due to the small numbers tested per year, with a peak of just 0.4% dogs in 2013 and 2015 (13 and 15 dogs respectively).

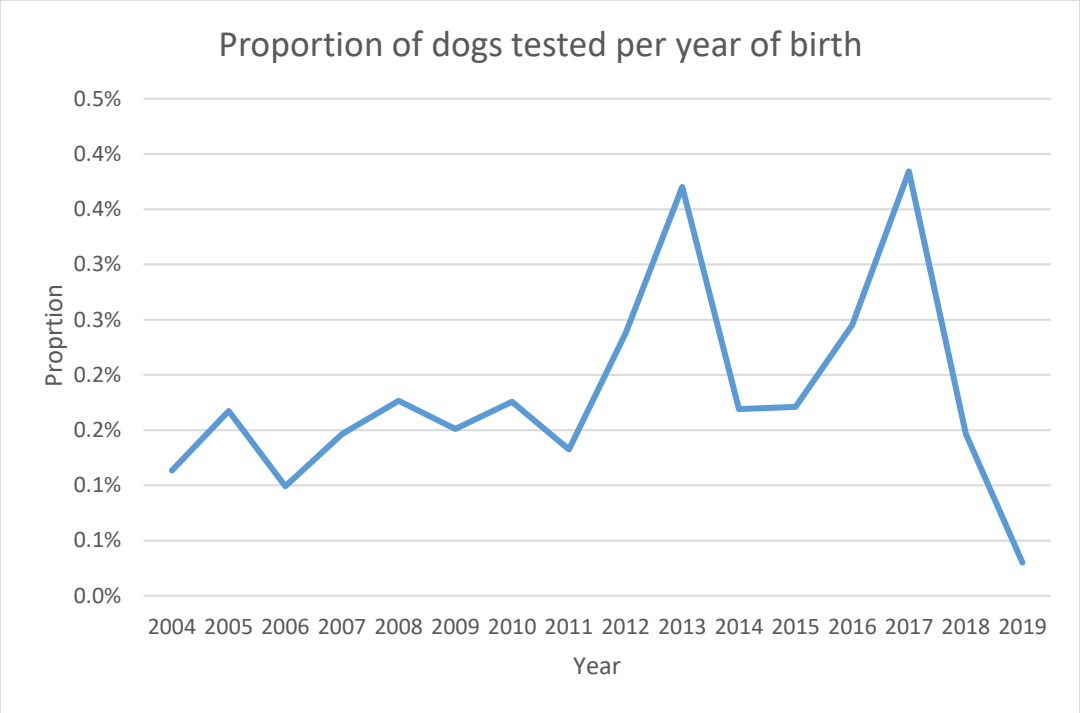

Figure 9: Proportion of dogs tested per year of birth for the past 15 years.

ELBOWS

To date (Sept 2021), 16 Boxers have been elbow graded under the BVA/KC Elbow Dysplasia Scheme with just one dog being graded 1 and the remaining grade 0.

EYES

The breed is not currently on the BVA/KC/ISDS Known Inherited Ocular Disease (KIOD) list (formally Schedule A) for any condition under the BVA/KC/International Sheep Dog Society (ISDS) Eye Scheme.

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.

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. Results of Boxers tested between 2012-2018 are shown in Table 19 below.

Table 19: Reports on Boxers that have participated in the BVA/KC/ISDS Eye Scheme between 2012-2018.

Year	Number Tested	Comments
2012	10 adults	5 – distichiasis 2 – entropion 5 – ectropion 1 – corneal lipid deposition 1 – anterior pigment deposition
2013	12 adults	7 – distichiasis 4 – entropion 4 – ectropion 3 – corneal lipid deposition 1 – iris cyst
2014	10 adults	5 – distichiasis 5 – ectropion 3 – corneal lipid deposition 1 – persistent hyperplastic primary vitreous
2015	9 adults	4 – distichiasis 2 – entropion 1 – ectropion 1 – multifocal retinal dystrophy
2016	4 adults	2 – distichiasis 1 – corneal lipid deposition
2017	5 adults	3 – distichiasis 2 – entropion 2 – ectropion 1 – nuclear cataract 1 – chorioretinopathy
2018	5 adults	1 – distichiasis
2019	*Awaiting report*	
2020	*Awaiting report*	

AMERICAN COLLEGE OF VETERINARY OPHTHALMOLOGISTS (ACVO)

Results of examinations through ACVO are shown in Table 20 below for conditions affecting over 1% of the examined population. Between 2015 and 2019, 266 Boxers were examined, of which 64.3% (171 of 266 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 20: ACVO examination results for Boxers, 1991 – 2019

Disease Category/Name	Percentage of Dogs Affected	
	1991-2014 (n= 1,618)	**2015-2019** (n= 266)
Eyelids		
Entropion	0.1%	1.9%
Ectropion	3.7%	3.8%
Distichiasis	11.7%	15.0%
Cornea		
Corneal dystrophy	8.3%	7.1%
Uvea		
Persistent pupillary membranes, iris to cornea	0.5%	1.5%
Persistent pupillary membranes, lens pigment foci/ no strands	0.1%	1.5%
Persistent pupillary membranes, endothelial opacity/ no strands	0.1%	1.1%
Lens		
Cataract, suspect not inherited/ significance unknown	2.3%	5.3%
Significant cataracts (summary)	3.3%	4.5%

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 21.

Table 21: Number of Boxer litters registered per year, and number and percentage of caesarean sections reported per year, 2010 to 2020.

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)*
2010	1015	6	0.59%	0.35%
2011	1018	14	1.38%	1.64%
2012	901	83	9.21%	8.69%
2013	738	67	9.08%	9.96%
2014	754	79	10.48%	10.63%
2015	655	72	10.99%	11.68%
2016	649	71	10.94%	13.89%
2017	657	72	10.96%	15.00%
2018	632	77	12.18%	17.21%
2019	601	64	10.65%	15.70%
2020	611	56	9.17%	14.41%

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 **111.5** was reported (estimated using the rate of inbreeding over the period 1980-2019).

An effective population size of less than 100 (inbreeding rate of 0.50% per generation) leads to a dramatic increase in the rate of loss of genetic diversity in a breed/population (Food & Agriculture Organisation of the United Nations, "Monitoring animal genetic resources and criteria for prioritization of breeds", 1992).

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 10. The rate of observed inbreeding increased until a peak in 2005 and since this time the rate has notably decreased.

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.

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

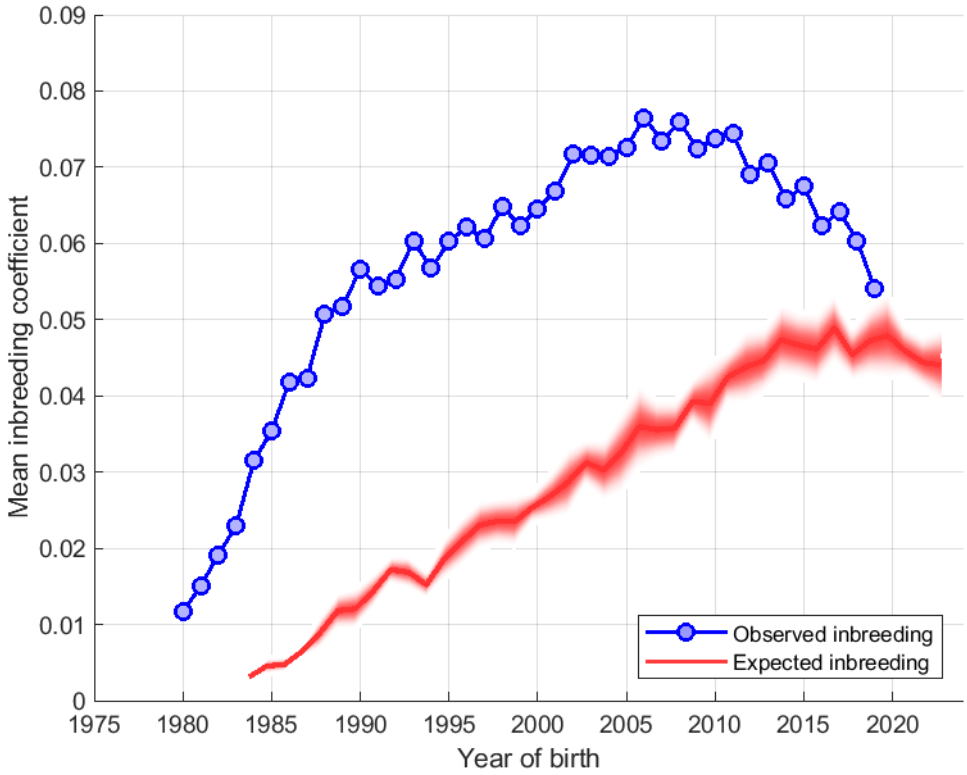

Figure 10: Annual mean observed and expected inbreeding coefficients. [The blurring around the expected inbreeding line indicates an approximate standard deviation around the estimate, in breeds with more than 2000 individuals born in a given year.]

The current breed average inbreeding coefficient is **5.3**%.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven five-year blocks (Figure 11). 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). There appears to be extensive use of popular dogs as sires in this breed (the 'tail' of the blue distribution in Figure 11).

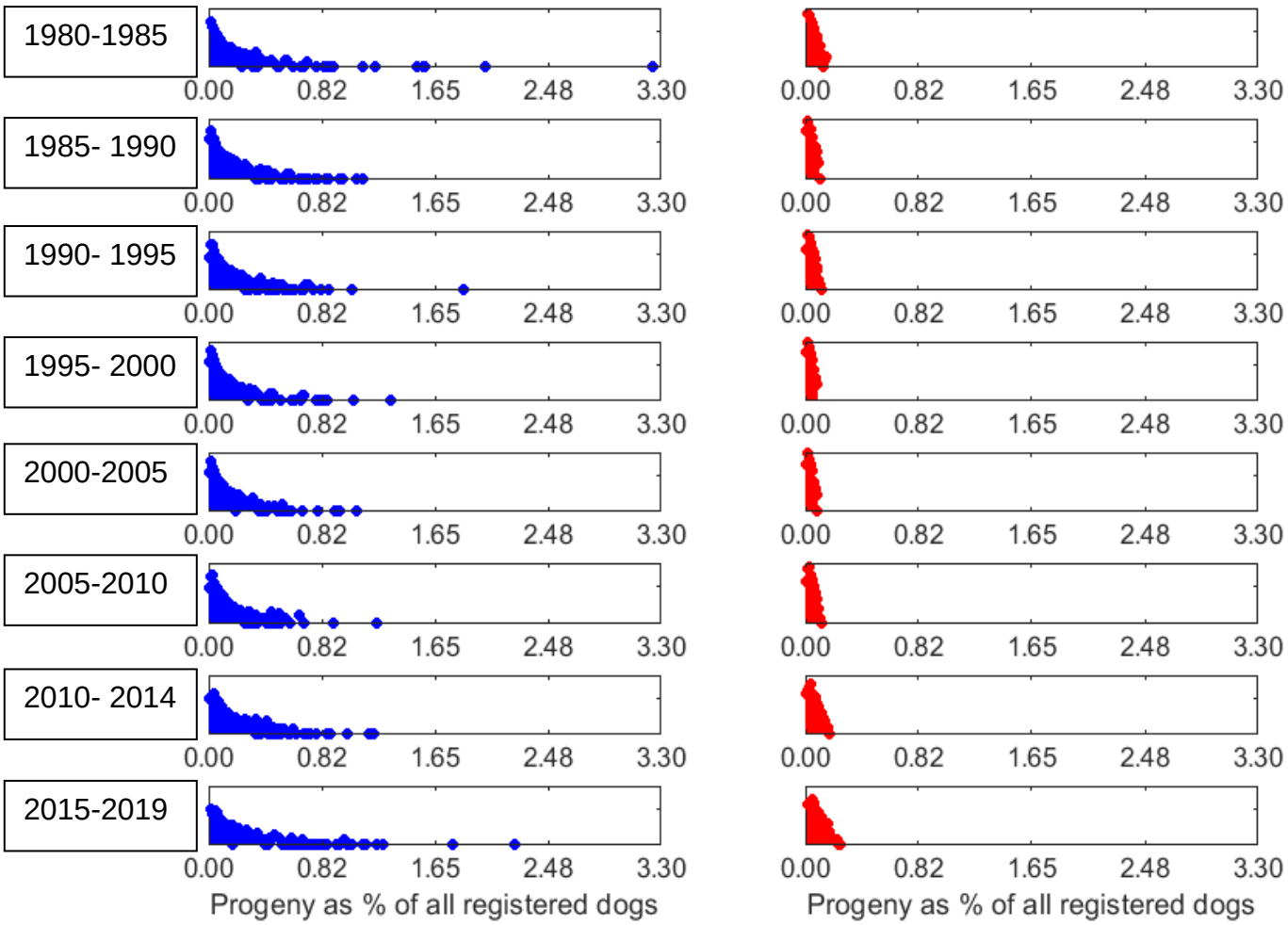

Figure 11: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-5 top, 2015-19 bottom). Vertical axis is a logarithmic scale.

CURRENT RESEARCH

There is research into the genetics of juvenile kidney disease was started at the AHT, in collaboration with researchers in Sweden. Professor Amos at the University of Cambridge and Professor Syme at the Royal Veterinary College are also undertaking research into the genetics of juvenile kidney disease in the breed.

The University of Cambridge's BOAS Research Group are also investigating airway disease in a number of brachycephalic breeds, including the Boxer.

Further, the breed have been working with Dr Hezzell at Bristol Veterinary School to identify biomarkers for cardiovascular disease.

PRIORITIES

Correspondence between the breed representatives and the Kennel Club was undertaken in September 2021 to discuss the evidence base of the BHCP and review the priority issues for the health of the breed. The group agreed from the evidence base that the priorities for the Boxer were:

- Heart conditions (particularly aortic stenosis and ARVC)
- Cancers
- JKD
- Skin conditions

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 Boxer. Both partners are expected to begin to action these points prior to the next review.

Breed Club actions include:

- The Kennel Club and Boxer breed clubs to monitor research relevant to JKD and look to put forward a proposal to the Kennel Club Charitable Trust for funding with the Kennel Club's assistance

- The breed clubs to continue to encourage participation in breed club heart testing – **ONGOING**

- The breed clubs to continue to engage in BOAS research with the University of Cambridge team

Kennel Club actions include:

- The Kennel Club to keep the breed updated with regard to the Veterinary Cardiovascular Society heart scheme – **ONGOING**

- The Kennel Club to monitor the AHT's research into cancers. – **ON HOLD**

- The Kennel Club to monitor the University of Nottingham research into atopy and assist in recruiting owners for the Itchy Dog Survey. – **ONGOING**

- The Kennel Club to assist with a breed health survey. – **COMPLETE**

- The Kennel Club to enquire about the possibility of a Boxer VetCompass study. – **COMPLETE**

- The Kennel Club to assist in recruitment of the JKD project and share health links from the council to the KC website

- The Kennel Club to monitor research options for lymphoma in the breed

- The Kennel Club to approach the BVA/KC/ISDS Eye Panel Working Party to explore the feasibility of recording adnexal conditions for brachycephalic breeds

- The Kennel Club to investigate the possibility of developing a formal thyroid testing scheme

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APPENDIX

Below shows the other conditions reported in the 2020 breed health survey:

Category/ Condition	Count	Category/ Condition	Count
Cancer/tumour/lump		***Hormonal***	
Benign lump/tumour	13	Thyroid disorder – unspecified	6
Oral growth (epulis)	4	Hypothyroidism	1
Mast cell tumour	2	Cushing's disease	1
Brain tumour	1	***Immunological***	
Melanoma	1	Lupus	1
Lung cancer	1	Sepsis	1
Focal/fibro adnexal dysplasia	1	***Rhinitis***	1
Polyp	1	Immune-mediated haemolytic anaemia	1
Dental		Immune-mediated thrombocytopenia	1
Overgrown gums	2	Aspergillosis	1
Dermatological		Pseudomonas aeruginosa	1
Allergies	12	***Muscle, bone or joint***	
Cysts	9	Arthritis	7
Histiocytoma	6	Tail injury	6
Skin tags	2	Cruciate ligament rupture	3
Skin problems – unspecified	2	Radial bone malformation	1
Acne	2	Tail dislocation	1
Hyperkeratosis	2	Fracture	1
Abscess	2	***Neurological***	
Dry flaky nose	1	Meningitis	6
Demodex mange	1	Undiagnosed syncope	5
Broken nail	1	Epilepsy	4
Ear		Seizures/ fitting	3
Deafness	3	Idiopathic head tremor	2
Ear infection	2	Drooping face	1
Detached ear drum	1	Dementia	1
Aural ablation	1	Brain problem – unspecified	1
Eye		Vestibular syndrome	1
Eye ulcer	1	Brain lesions	1
Gastrointestinal		Spinal stroke	1
Pancreatitis	12	Horner Syndrome	1
Anal gland disorder – unspecified	4	Vasovagal	1
Food intolerance	3	***Reproductive***	
Vitamin B12 deficiency	2	Cryptorchidism	4
Colitis	2	Enlarged prostate	3
Intussusception	2	Phantom pregnancy	1
Anal gland abscess	1	Vaginal deformity	1
Vomiting	1	Testicular problem – unspecified	1
Bloat	1	***Respiratory***	
Faecal impaction	1	Heavy breathing	1
Gastric reflux	1	Stenotic nare (pinched nostril)	1
Giardia	1	Pneumonia	1
Sensitivity	1	Soft palate disorder	1
Enteropathy	1	***Renal***	
Heart		Urinary incontinence	5
Heart murmur	2	Kidney disease – unspecified	2
Cardiomyopathy	2	Urinary tract infection	1
Haematological		Single kidney	1
Spleen removal	2	***Other***	
Ruptured spleen	1	Grass seed infection	1
Nodules on spleen	1	Hay fever	1
Blood granules on leg	1	Hypersensitivity disorder	1
Angiomatosis	1	Sleep apnoea	1