Report of the UK Bearded Collie Breed Liaison Committee Health Survey 2007-2011

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Introduction

The development and maintenance of a breed requires artificial selection for specific, usually physical, traits as indicated by the breed standard. This inevitably leads to a smaller gene pool and often the traits desired to meet a standard are uncommon in the normal population and potentially are mutations that have health implications in their own right. In addition, selection for specific characteristics means that there is an increased likelihood of 'hidden' deleterious genotypes also being introduced and maintained in the population. Put concisely, breeding of pedigree dogs can lead to breed specific health problems (CAWC, 2006) that have welfare implications for individual animals. With the passing of the Animal Welfare Act 2006, all individuals have a duty of care to animals for whom they are responsible. This includes breeders of dogs, and by default those who set breed standards (Lewis, McBride and Lamb, 2009). It is thus incumbent on Breed Societies to take steps to ensure the breed standard does not compromise dog health, and that dogs used in breeding programmes are identified, as far as current science can so do, to be healthy and without genotypes that can pass on health issues to future generations, whether or not the individual dog itself is displaying such symptoms. It is a contravention of the UK Animal Welfare Act 2006 to not take reasonable steps to ensure the health of a dog. It is a reasonable argument that this responsibility extends to those breeding future generations, i.e. those responsible for the current and future health of the foetus/neonate in so far as that health relates to the dog's genotype. To the authors' knowledge this has not yet been tested in the UK courts, but this is likely to simply be a matter of time.

The Bearded collie has been traced back as a working breed in Scotland and Northern England for 500 years, used as a herding and droving dog. However, the modern Show type dates back to the 1940s to a breeder, Mrs G. O. Willison, whose bitch Jeannie and stud Bailie founded the Bothkennar kennels (Kennel Club, 2015) and the consequent change from working type (Figure 1) to the founding show type (Figure 1a) to the modern show type (Figure 2).

Figure 1 traditional Bearded Collie circa 1915

Photograph from http://en.wikipedia.org/wiki/Bearded_Collie

Figure 1a Jeannie of Bothkennar (1949), a founding bitch of the modern KC registered Bearded Collie

Photograph from www.4.bp.blogspot.com

Figure 2 Modern UK Bearded Collie

Photograph from Marc Henrie / The Kennel Club ©

Breed related issues are a particular concern for the Bearded Collie. The current KC registered stock, dating from the mid-1940s, was achieved from an extremely small number of dogs. This original limited gene pool, combined with subsequent selection for breed characteristics through inbreeding and the over use of popular sires, carries an enhanced risk of unfortunate gene mutations occurring, being carried and spreading through the population. These breeding practices have also led to a seriously decreased genetic diversity. A study into Effective Breeding Populations carried out by the Kennel Club in conjunction with the Animal Health Trust since 2009 aims to record and analyse how many genetically different dogs contribute to specific breeds. Early in 2013 the calculated the Bearded Collie Effective Breeding Population was 20, placing the breed in the danger zone in terms of its future health (Kisco, pers comm UK Kennel Club 2013). It should be noted that a breeding population score of above 80 is desirable for a breed's genetic diversity to be considered healthy.

For breeders it is important to consider the Inbreeding Co-efficient of dogs they may wish to mate. Every June, the UK Kennel Club calculates the average inbreeding co-efficient for each breed from all data available from dogs registered with the UK Kennel Club. Prior to 2014 this was based on all dogs registered in a year, subsequently it is based on all those born (and registered) in a 12 month period from January and December of the previous year. In June 2014, thus relating to dogs born in the calendar year 2013, the average breed score for the Bearded Collie was 12.9. To contextualise, a score of 12.5% represents a genetic equivalent of 2 generation difference mating i.e. a grandparent mated with grandchild, and 25% that of a one generation difference mating i.e. parent mated with their own offspring (Kennel Club 2015).

It is generally assumed that the Bearded Collie as a breed has few health problems, but as with many breeds there is little reliable data. The Universities Federation for Animal Welfare is compiling a website of Genetic Welfare Problems of Companion Animals which, as yet, does not include the Bearded Collie. However, as stated on their website (UFAW 2015) (www.ufaw.org.uk/dogs.php) "The collection of information and development of this site is a `work in progress'. Non-inclusion of a breed or condition at this time does not necessarily mean that the breed has no genetic disorders or that the condition is not a problem."

Only two studies relating to the health of Bearded Collies in the UK are known to the authors. The first is Hamilton-Andrews (1998) who investigated relationships between hypothyroidism and behaviour in Bearded Collies. The second, more recent work was the 2004 Kennel Club / BSAVA Purebred Dog Health Survey. Data from 563 live dogs was obtained in the Kennel Club (2004) survey and data for 278 dogs that had died. The mean age of death was 12.6 years (s.d. 3.7), the oldest being 19.5 years. Old age accounted for 25.95% of these deaths, and cancer a further 19.4%. Of the 563 live dogs, the average age at the time of the survey was 7.02 years (s.d. 4.197) and ranged from 2 months to 16.5 years. 278 were reported as having one or more disease conditions, with 437 conditions recorded, of which 14.4% (n=63) were musculo-skeletal, most commonly arthritis and cruciate ligament rupture, and 12.6% (n=55) gastrointestinal, notably colitis and diarrhoea. This survey questionnaire was relatively brief and generalised. Thus it is limited in not allowing for any associations to be made between, for example, gender and specific conditions (Kennel Club 2004).

The only other health survey data that is known to the authors is that of Sell (1998) from data collected in 1997-8 in the USA and Canada. The most commonly reported health problems in the

USA/Canada study were hypothyroidism, cancer, Addison's disease, arthritis and skin problems. Addison's disease (insufficient production of glucocorticoids and/or mineralocorticoids in the adrenal cortex) occurred in 4.7 % (66/1397) of Beardies in the USA/Canada survey. In the UK Kennel Club (2004) survey Addisons accounted for 1.1% (3 of 278) deaths.

This current study aimed to assess the health of the Bearded Collie in the UK in the first decade of the 21st century. Data was collected in 2012 regarding dogs owned in the period January 2007 – January 2012, i.e. calendar years 2007 - 2011. During this period, 2784 new registrations of Bearded Collies were recorded with the Kennel Club. These would have included including puppies and imports from overseas. There were of course other dogs registered prior to this, some of whom will have been included in the sample. The survey asked owners to provide data on dogs they had previously or currently owned during the study period, thus the data also referred to dogs that had died during that period.

The findings will add to current knowledge and help inform professionals and lay persons interested in the health of this breed in particular, or in the health of pedigree dogs in general, be they prospective owners, breeders or members of the veterinary profession. The Bearded Collie Clubs of the UK and Kennel Club can use the data to assist in making informed decisions regarding the future of the breed, for example in respect of the requirements for voluntary or compulsory testing for conditions or other restrictions relating to future breeding.

Method

Participants

Participants were recruited through advertising via UK Bearded Collie national and regional clubs, UK Kennel Club, Dog magazines and snowballing technique.

Owners were all UK residents. 189 owners completed the survey for two dogs, and 87 for three dogs, the rest answered in respect to a single dog. All had been owned between January 2007 and January 2014. In total, data for 789 dogs was collected, of which 700 were registered with the UK Kennel Club. It is this registered population (n=700) that comprised the sample for analysis.

Procedure

A customised questionnaire was developed by the Bearded Collie Breed Liaison Committee with input from the academic advisor. This was hosted on the University of Southampton's I-survey site, and participants could also request and return a paper copy. 6 paper copies were returned and the data entered to the online survey.

Inclusion criteria were that respondents had to live in the UK, be over 16 (the legal age for dog ownership in the UK) and to have owned the Bearded Collie dog, for which they were giving data, between January 2007 and January 2012.

Ethics and Association

Ethics approval for the study was obtained from the University of Southampton Psychology Ethics committee.

The study was in part funded by a grant of £800 from The Kennel Club Charitable Trust.

Questionnaire Design

The questionnaire comprised 4 main sections (Appendix 1). Sections 2-4 were repeated for each new dog, up to 3 dogs in total, thus participants could fill in a questionnaire for 3 dogs at a time. They were able to complete the survey again for any additional dogs they owned. Due to data protection issues, it is not known how many surveys a single owner may have completed.

Section 1 – Owner demographics. This asked questions about where the owner lived e.g. urban, rural; their length of ownership of BCs, how many they owned between Jan 2007 - Jan 2012 and the number of adults and children in household.

Section 2 – Dog Demographics. This section asked questions about whether the dog was KC registered or not; its age, gender, coat colour and if deceased, age at death and reason for death. Further questions provided data regarding vaccination status; neuter status, reasons for neutering; diet; length of daily exercise, and physical and mental activities. For analysis purposes the following data rationalisation was conducted

Diet: For analysis purposes diets were collapsed into 3 categories

- Commercial (combining commercial wet, dry and other)
- Homemade and Raw
- Other

Vaccination: options were Annually, Every x years (all responses were between 2-4 years); Puppy vaccination only, Titre testing, Never or other.

In order to test the effect of vaccination against illness, other was excluded, and 3 categories made:

- Never,
- Puppy Only,
- Vaccinated (annually, every x years, titre).

Daily Exercise: an average daily length (minutes) of exercise was calculated by the following equation [(5 x average working day) + (2 x average leisure day)]/7

Mental exercise score of 0 – 5 was calculated by summing the number of the following activities the dog did / had done:

- Breed showing
- Puppy classes
- Obedience classes
- Obedience competitions
- PAT dog (Pets as Therapy)

Physical exercise score of 0 – 5 was calculated by summing the number of the following activities the dog did / had done:

- Agility classes/competitions
- Heelwork to music
- Working trials or nosework
- Fly Ball
- Herding

Section 3 – Health related issues. This comprised 18 subsections relating to different areas of health within which various issues were identified, for example under Blood Disorders, Anaemia and Leukaemia were identified. The 18 areas of health were:

Blood disorders	Immune system
Ears	Musculo-skeletal
Cancers/Tumours	Ocular
Heart	Parasites
Cerebral Vascular	Reproductive female Reproductive male
Dental	Respiratory
Skin	Urologic
Endocrine	Infectious
Gastrointestinal	Other

For each section, owners were asked to tick if the dog had suffered a particular issue and indicate the age of onset if known.

For analysis purposes a further category of *Autoimmune disorders* was created by combining the following 14 conditions

- Haemolytic Anaemia
- Thrombocytopenia
- S.L.O. (Biopsy confirmed)
- S.L.O. (Unconfirmed, presumptive diagnosis)
- S.L.E
- Steroid Responsive Meningitis / Arteritis SRMA
- Myasthenia Gravis
- Polyarthritis IMPA
- Rheumatoid Arthritis
- Diabetes Mellitus
- Addisons's disease
- Pemphigus Foliaceus
- Discoid / Cutaneous Lupus
- Unspecified

Section 4 – Temperament and Behaviour: 5 point Lickert style questions from 1 (Never) to 5 (Always) were asked about various aspects of behaviour including nervousness, resource guarding, home alone issues and sound sensitivity issues. There was consideration of using the CBARQ (Hsu and Serpell, 2003), but this was deemed as too extensive and detailed given the aims of the study and the length of the questionnaire.

For analysis the following measures were used

Nervousness score: single item "is this dog nervous?" Score 1-5 Higher score = more nervous

***Total Friendliness score**:* the overall mean from the following questions (score 1 – 5, Higher score = more friendly)

Is this dog friendly with..

- Known adults
- Unknown Adults
- Known dogs
- Unknown dogs

***Total Sound Sensitivity**:* Though this was a five point Lickert scale, the data spread was such that few dogs were recorded in the middle range. Thus scores were combined to give a score of 0 if they ticked Never, Rarely or Sometimes and a score of 1 if Often or Always was recorded.

A total Sound Sensitivity Score (range 0 -3) for each dog was calculated from the sum of scores across

- Fireworks
- Gunfire
- Thunder

***Total Home Alone Problems**:* the overall mean from the following questions (score 1 – 5, Higher score = more issues when alone)

When left alone at home does this dog

- Settle down quietly (reverse scored)
- Become destructive
- Become noisy?

There was insufficient numbers reported to analyse this question.

Results

Results are reported, in some instances owners did not complete all the questions and thus there is some missing data.

This report addresses all the major findings, complete data analysis is provided in the additional documents.

Demographics

Data for 700 dogs was obtained, of these 511 were alive and 188 were dead, one respondent did not say if the dog (male entire) was alive or dead.

39.45% (74) dogs had died of old age and 57.4% (108) from a medical condition (Table 1).

Table 1: Demographics of Dead dogs and number dying through old age, medical condition or accident.

		Age Died (Months)				Old age	Medical	Accident
	N	M	SD	min	max			
All dogs	188	158.46	35.29	17	239			
M	73	152.12	36.24	17	239			
F	115	162.49	34.23	27	238			
ME	52	152.06	36.01	17	211	16	35	
MN	21	152.29	37.69	88	239	6	14	1
FE	39	152.64	40.49	27	209	17	20	
FN	76	167.54	29.56	76	238	35	39	1

511 dogs were recorded as alive (Table 2) but, 1 alive dog did not record gender or neuter status, 1 alive dog was neutered but had no gender and 1 alive female was not recorded as to whether she was neutered.

Table 2: Demographics of living dogs

Living Dogs	N	Mean age (months)	S.D	Min	Max
All dogs	511	82.67	47.85	2	206
All males	245	81.75	46.33	2	185
All Females	263	83.44	49.46	2	206
Male Entire (ME)	158	78.17	46.51	2	185
Male Neutered (MN)	87	88.69	45.46	10	178
Female Entire (FE)	153	75.44	49.81	2	206
Female Neutered (FN)	110	94.19	47.10	3	200

For the rest of the analyses, unless stated, data from the living and deceased dogs were combined. Thus, the sample of 700 dogs comprised 319 males, 211 entire and 108 neutered; and 379 bitches of which 192 were entire and 186 neutered.

Breeding and Neutering

108 males had been neutered. The average age of neutering was 29.2 months (n=61, s.d. = 32.2) with a range from 5 to 168 months. 3 neutered males were cryptorchid and 7 monorchid.

185 bitches had been neutered (spayed). The average age of spaying was 53.1 months (n=127, s.d. = 42.3) with a range from 6 to 186 month.

From the total of all 700 dogs, 134 bitches and 50 males had been used for breeding.

56 breeding bitches had subsequently been spayed (mean age of neutering 86.8 months, s.d.= 24.6, n=37) as had 7 males, of whom only 3 gave the age at which they were neutered, ranging from 48 to 132 months.

The most common reasons for neutering for both sexes, regardless of breeding history, were "*did not wish to breed*" (males: 24/95 responses; females: 64/174 responses)) and "*to avoid future medical problems*" (males: 35/95 responses; females: 68/174 responses). 26 males and 6 bitches were neutered for behavioural reasons; 7 males and 3 females because of inherited abnormalities (none of this latter group had been used for breeding).

14 bitches not used for breeding and 11 that had been bred were spayed due to having developed pyometra.

39 neutered dogs (5 male, 34 female) and 7 entire (4 male, 3 female) were recorded as incontinent. There was no significant association between incontinence and age of neutering.

24 of the bitches used for breeding had had a Caesarean. Of these 5 were incontinent, these 5 were all spayed.

The data does not enable any comment as to whether incontinence occurred before or after neutering.

False Pregnancy: 37 bitches (19 entire, 18 spayed) had suffered from false pregnancies. There were no instances of these dogs also having had pyometra.

Mammary tumours: 13 bitches had had mammary tumours; 5 of whom had also had false pregnancies. There were too few dogs to test any association.

Coat colour

54.5% of the dogs (n=649) were slate coloured and 35.1% brown or black (Table 3)

Table 3: Coat colour by gender

	Males	Bitches	total
Slate	161	193	354
Brown	56	65	121
Black	53	54	107
Blue	14	29	43
fawn	13	7	20
White	2	1	3
merle	0	1	1
			649

Management

Diet: data was collected for 604 dogs (294 males and 310 females). Two thirds were fed commercial dry food (Table 4).

Table 4: Diet by gender

	Commercial dry	Commercial wet	Commercial other	raw	homemade	other
Male (n=294)	198	15	12	36	13	20
Females (n= 310)	204	15	16	59	13	38
total	402 (66.5%)	30 (4.9%)	18 (2.9 %)	95 (15.7%)	26 (4.3%)	58 (9.6%)

Exercise:

Physical:

On average, female neutered dogs engaged in less average daily exercise (minutes) (M = 99.05, SD = 59.98 n=185) than female entire dogs (M = 115.16, SD = 95.78 n=192). Likewise, on average, male neutered dogs engaged in less average daily exercise (M = 99.31, SD = 69.51 n=108) than male entire dogs (M = 109.20, SD = 53.38 n=211). However, these differences were not significant in either case and the standard deviations were large in all groups.

Most dogs (237 males, 283 females) did not take part in any of the physical exercise activities, 66 males and 72 bitches took part in one of the activities, with 16 males and 23 bitches involved in two to four activities.

Mental:

81 males and 80 bitches had not been involved in any of the mental activities asked about. Only 54 males and 85 bitches took part in three or more activities. The most common activities were puppy and obedience classes and breed showing.

Vaccination

Owners were asked to identify the vaccination routine for their dog, 578 responded. This data is summarised in Table 5

Table 5 Vaccination Routines by gender

	Male	Female	Total
Never vaccinated	5	11	16
Puppy Only Vaccination	53	95	148
•Vaccinated (annually, every x years, titre)	205	209	414

Physical issues

75.29% (n=527) of the sample reported at least one illness, not including parasitic infection (Figure 3). Figures 3 and 4 and Table 6 give the breakdown by illness, and by gender

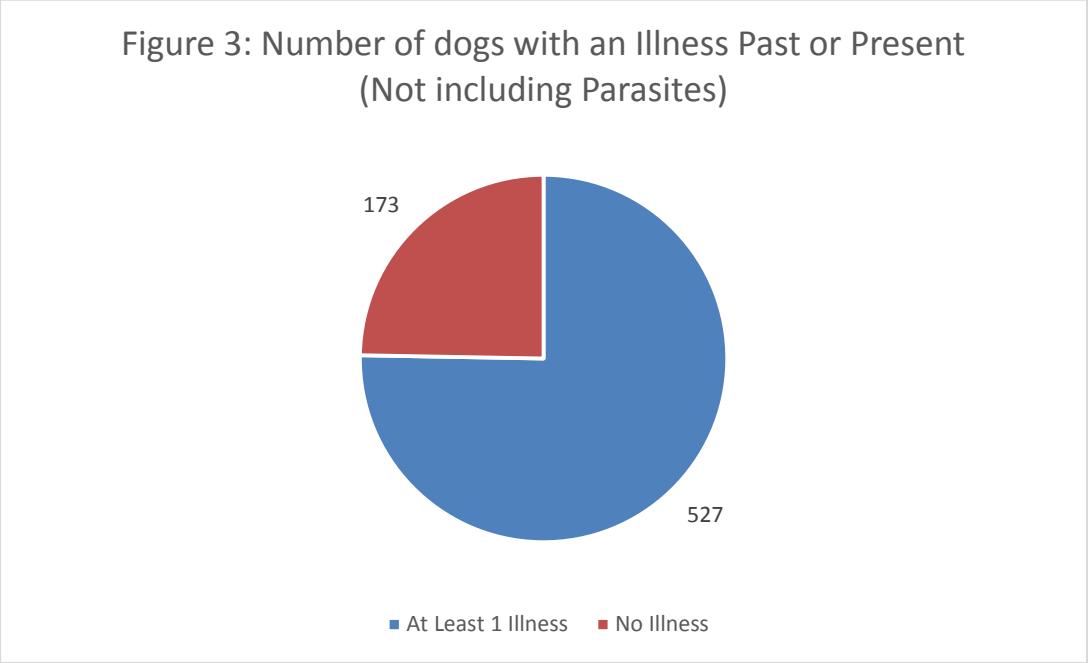


Figure 4 shows frequency by the categories of illness: note dogs can be recorded as having more than one illness.

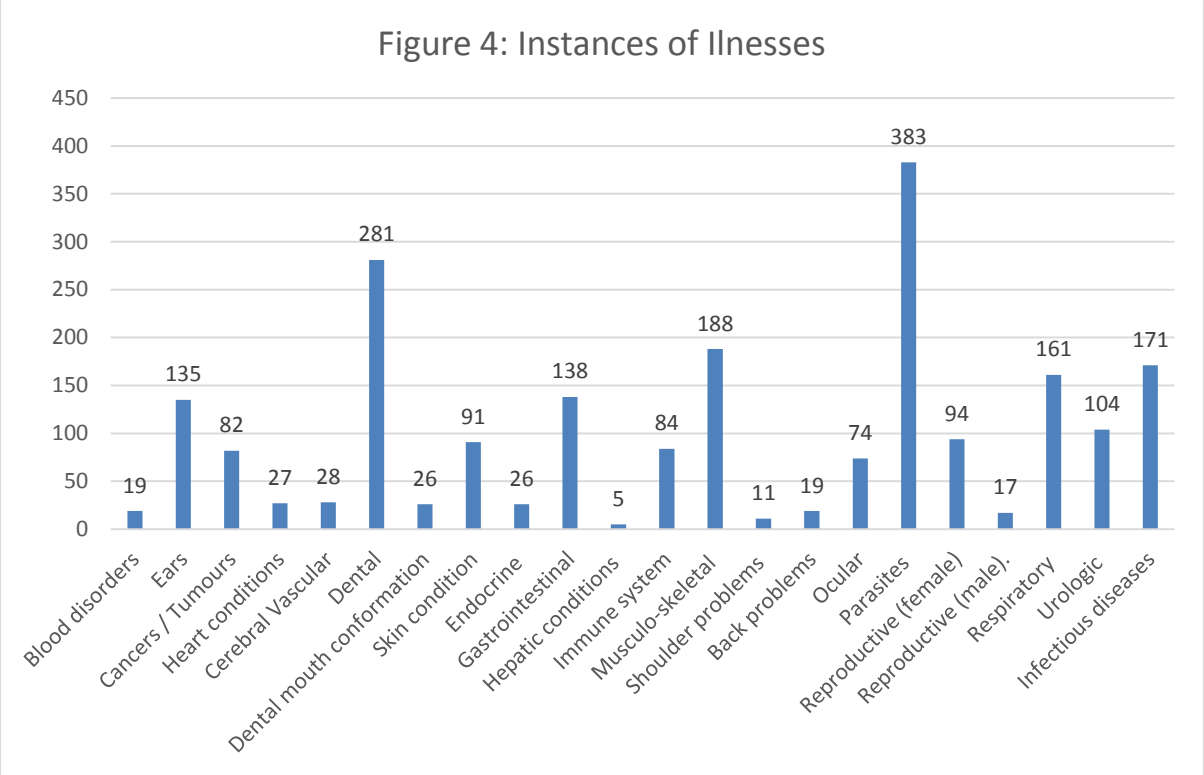


Figure 4: Instances of Ilnesses
450
400
350
300
250
200
150
100
50
0
19
135
82
27
28
281
26
91
26
138
5
84
188
11
19
74
383
94
17
161
104
171
Blood disorders
Ears
Cancers / Tumours
Heart conditions
Cerebral Vascular
Dental
Dental mouth conformation
Skin condition
Endocrine
Gastrointestinal
Hepatic conditions
Immune system
Musculo-skeletal
Shoulder problems
Back problems
Ocular
Parasites
Reproductive (female)
Reproductive (male).
Respiratory
Urologic
Infectious diseases

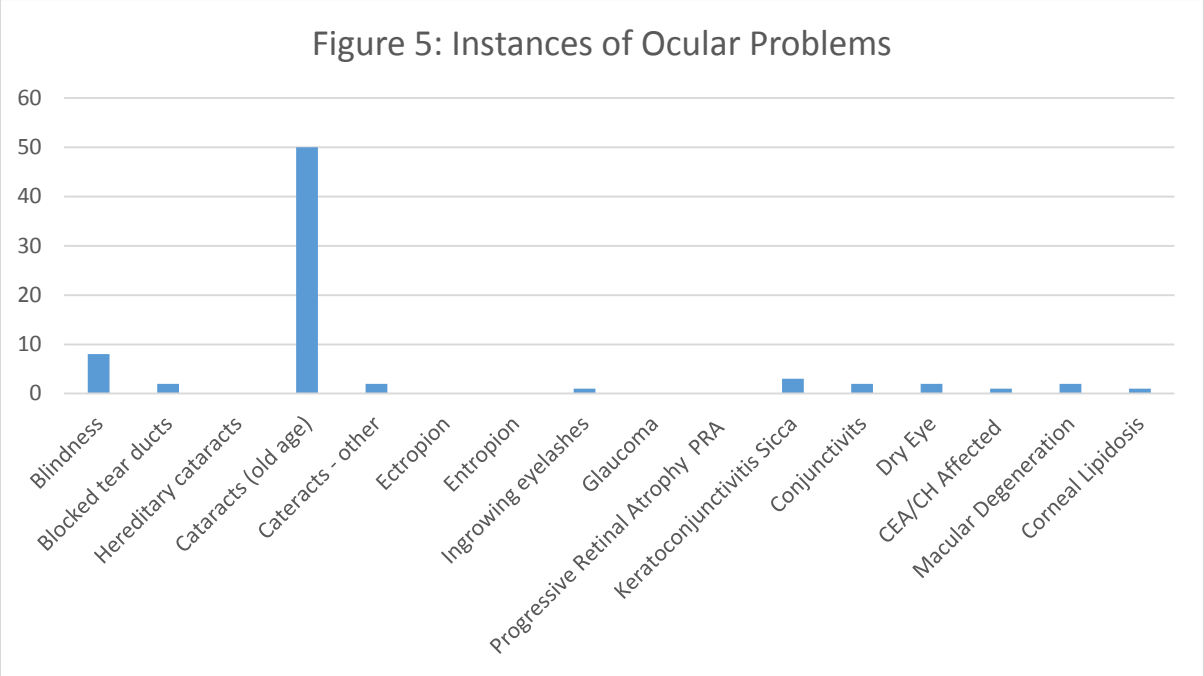
Table 6: Frequency of condition by gender (note some missing data where gender is unknown)

	male	female	Male entire	Male neutered	Female Entire	Female spayed
Blood	6	11	4	2	5	6
Ears	60	65	28	32	20	45
Cancers	31	46	20	11	17	29
Heart	11	14	3	8	7	7
Cerebral vascular	11	17	5	6	4	13
Dental	109	144	86	23	79	65
Mouth conformation	9	11	3	6	5	6
Skin	47	37	27	20	23	14
endocrine	10	15	4	6	7	8
Gastro intestinal	59	60	37	22	32	28
Hepatic	1	3	1	0	0	3
Immune	28	44	17	11	24	20
Musculo-skeletal	82	70	52	30	29	41
Shoulder	6	5	-	-	-	-
Back	9	8	-	-	-	-
Ocular	23	47	12	11	13	34
Parasites	120	139	76	44	69	70
Reproductive female	-	73	-	-	30	43
Reproductive male	17	-	5	12	-	-
respiratory	78	79	62	16	40	39
urologic	20	77	12	8	21	56
Infectious Note: all were kennel cough	77	94	56	21	48	46

Sensory issues

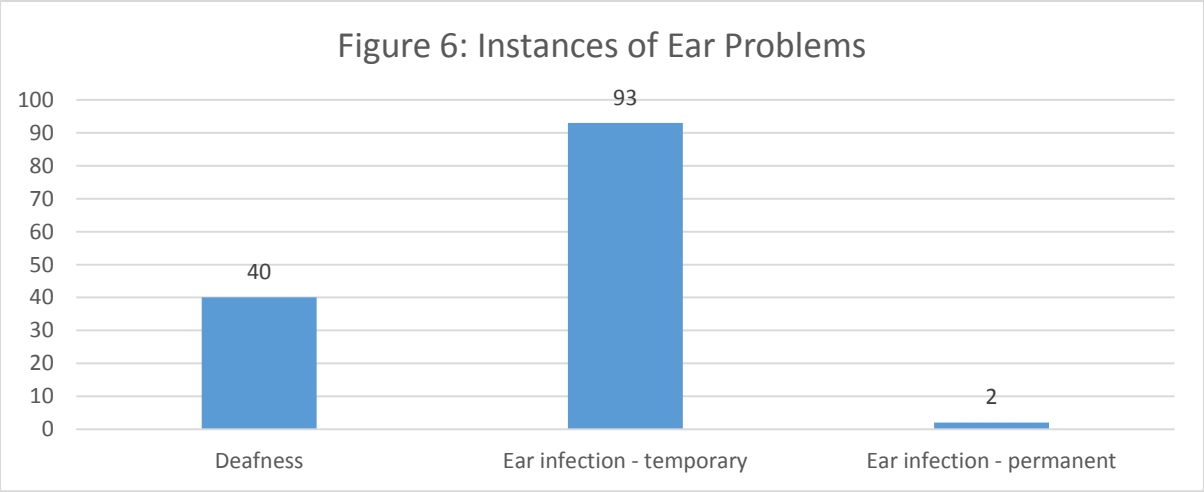
Sight

As shown in Figure 5, 50 were recorded as having old age related cataracts and 8 as blind, 3 of which also had old age cataracts. The average age of onset for blindness was 132.6 months (but note this average could only be calculated from 5/8 of the cases due to ambiguous age of onset responses due to questionnaire design logic online).



Hearing

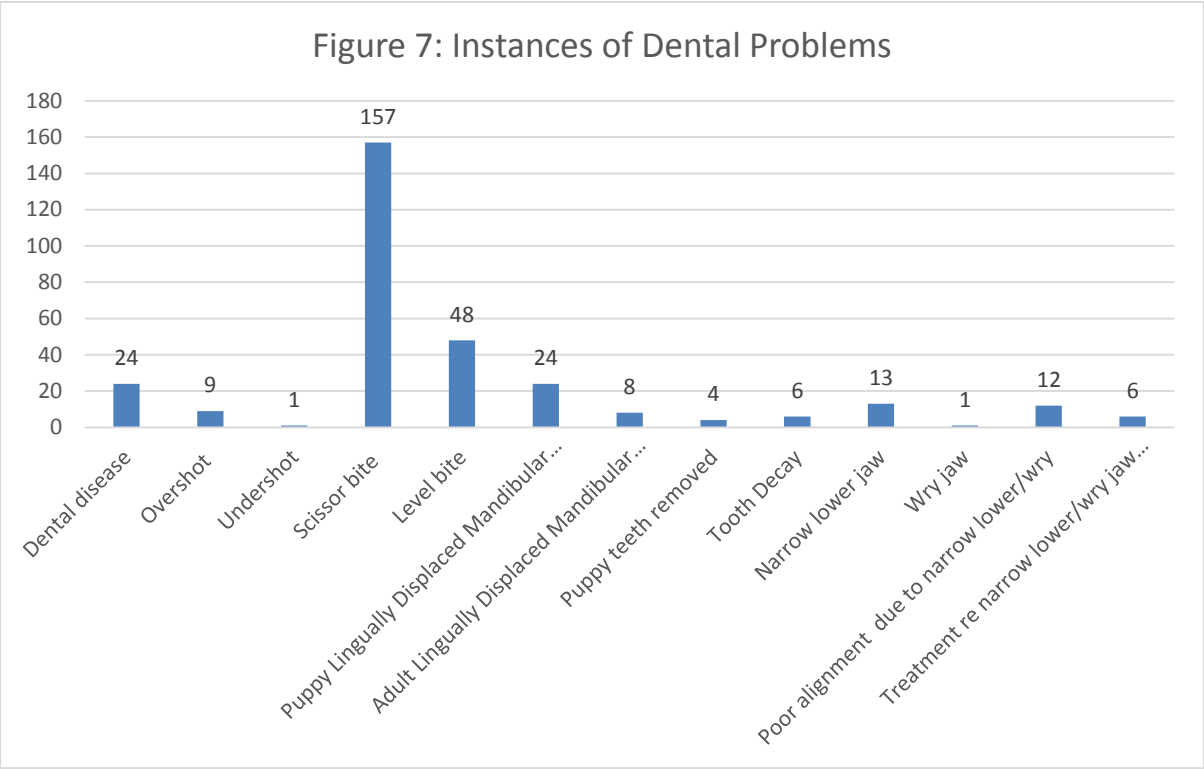
40 dogs were reported as deaf (Figure 6)



There were too few cases for any analysis of deafness by coat colour. There is the suggestion in the literature that this may be associated with merle and/or white coats. There were only 3 white dogs in the sample, 2 of which were not deaf, there was one merle bitch in the sample that also was not deaf.

Dental

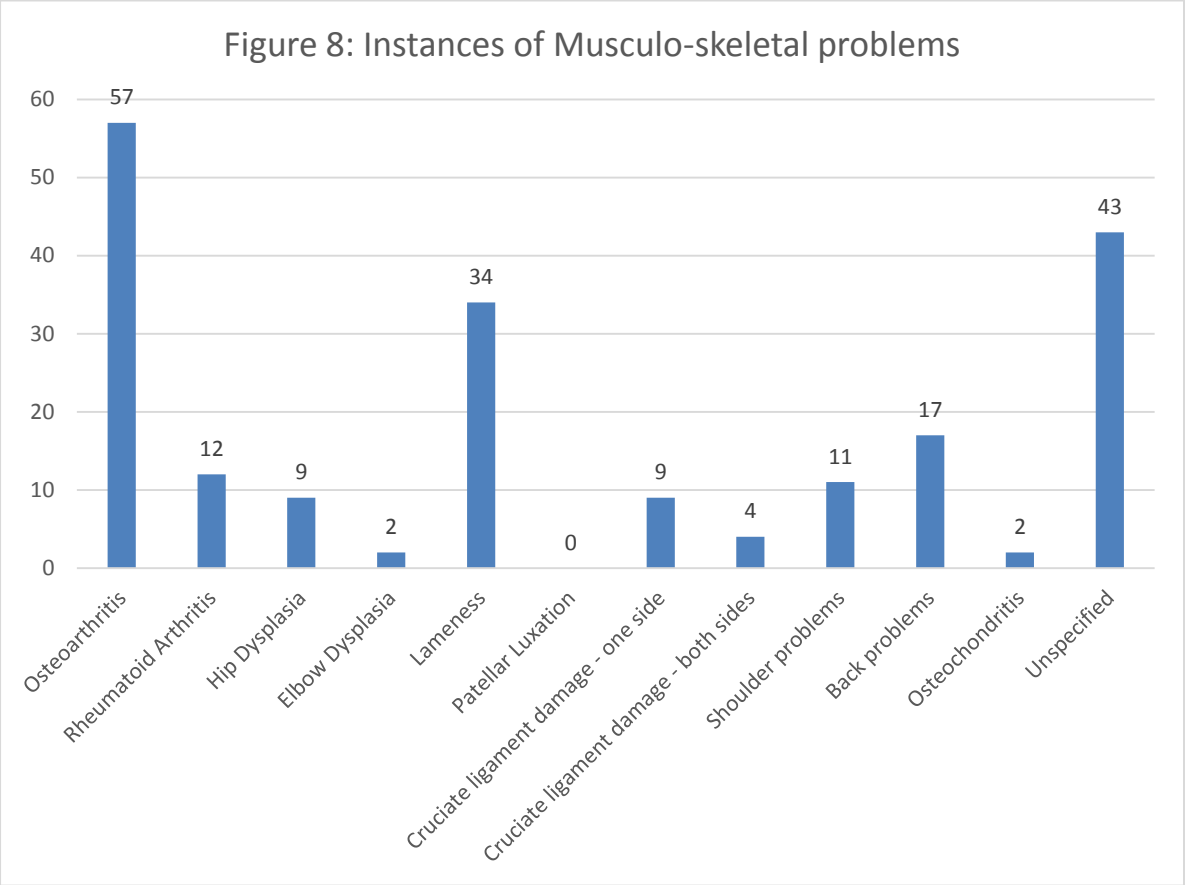
A range of dental problems were recorded, but all at low levels with most dogs having a scissor or level bite, both of which are accepted in the breed standard (Figure 7).



The one dog recorded as Wry Jaw also had Narrow Jaw and Lingually Displaced Mandibuar. Of the 13 dogs with narrow / wry jaw, 6 had had treatment.

Musculo-Skeletal Problems

From Figure 8 it can be seen that there were 43 incidents of unspecified MS problems and 34 cases of lameness, with no other information about cause. 57 dogs had osteoarthritis.



Effect of Neutering and Musculo-skeletal disorders

Point-biserial correlation revealed that age of neutering did not affect whether a dog developed any musculo-skeletal disorder in either males rpb = .15, p = .261, or females rpb = .07, p = .387.

With respect to osteoarthritis only, age of neutering was not significant for bitches (rpb = .001, p = .987. In males, the correlation between the average age of neutering and development of osteoarthritis was borderline significant rpb = .25, BCa CI [-0.018, 0.526], p = .050, in the direction of risk of developing a disorder increasing as age when neutered increased. It should be noted that the age of neutering was wide across the sample.

It must be remembered that correlations only show associations, not causal relationships. Thus it cannot be concluded from the data that age of neutering per se increases likelihood of developing osteoarthritis.

Effect of Exercise and MS disorders.

There was insufficient data to assess the effect of physical activity score on overall Musculo-skeletal issues. With respect to the average amount of daily exercise, there were no significant associations for whether male dogs developed a muscluo-skeletal disorder (rpb = .01, p = .939), but did significantly predict development of a musculo-skeletal disorder in females rpb = .11, BCa CI [.038, .190], p = .027, with risk of developing a disorder increasing as amount of exercise increased.

Again this is correlational data so causal explanations cannot be deduced.

With respect to osteoarthritis alone, daily amount of exercise was not significant for any gender, and there was not enough data to analyse physical exercise scores.

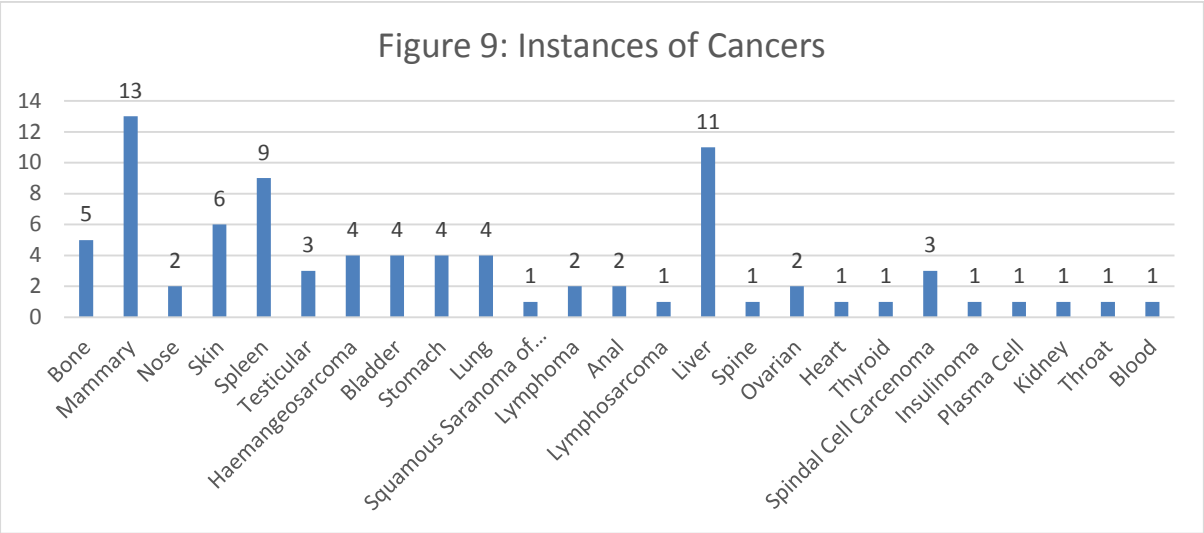
With respect to back problems alone there was insufficient number of cases (9 male, 8 female) to perform analysis to see if there was any effect of physical activity scores. With respect to average daily amount of exercise, no significant association with back problems were found (males rpb = .02, p = .701, females rpb = .01, p = .780), this could reflect the low number of cases.

With respect to shoulder problems alone there was insufficient number of cases (6 male, 5 female) to perform analysis to see if there was any effect of physical activity scores. With respect to average daily amount of exercise, no significant association with shoulder problems were found (males rpb = .03, p = .628, females rpb = .02, p = .654). Nor were any significant associations found when shoulder and back problems were combined. Again, these findings must be interpreted with caution due to the low number of cases.

Further analysis was undertaken to look to see if type of activity (combining agilty and flyball) was associated with back or shoulder problems. However, there were too few cases to analyse. That is too few dogs did agility/ flyball and had back /shoulder problems.

Cancers and Tumours

The incidence of individual cancers and tumours were too low to perform any analysis. 11 dogs were reported with liver cancer and 13 bitches with mammary tumours.



Autoimmune disease

Overall 72 (10.3%) of the dogs were recorded as having at least one autoimmune disease. These were 28 male (17 Entire, 11 Neutered) and 44 bitches (24 entire, 20 spayed). 84 incidences of autoimmune disease were recorded, see Figure 10, and distributed across genders as shown in Table 7

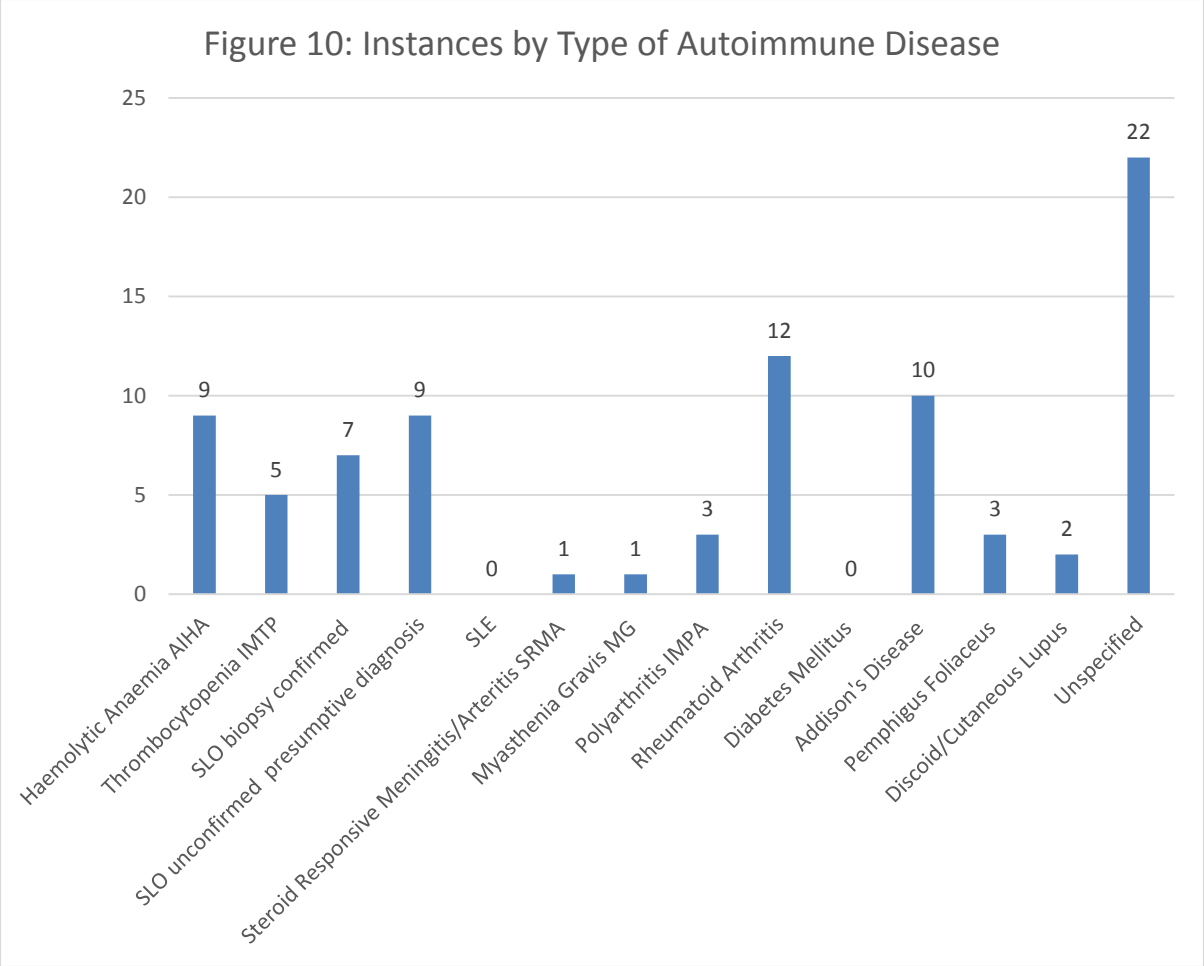


Table 7 Autoimmune disorder by gender

	Male entire	Male neutered	Female entire	Female Spayed
Haemolytic Anaemia	2	0	5	2
Thrombocytopenia	5	0	1	3
SLO Confirmed	1	2	0	4
SLO Unconfirmed	3	2	4	0
SLE	0	0	0	0
SRMA	0	0	1	0
MG	0	0	1	0
Polyarthritis	0	0	2	1
Rheumatoid Arthritis	2	2	2	6
Diabetes Mellitus	0	0	0	0
Addison's	3	1	2	4
Pemphigus Foliaceus	0	2	0	1
Discoid Cutaneous Lupus	0	0	1	1
Unspecified	8	3	9	2

Respondents were asked if they knew if any of the dog's relatives had autoimmune disease (regardless of whether their own dog had).

71 owners of dogs with Autoimmune disorder responded, 13 said No relatives had autoimmune disorder, 18 that some relatives did and 40 did not know.

547 owners whose dogs did not have Autoimmune disorder responded, 251 said No relatives had Autoimmune disorder, 51 that some relatives did and 246 did not know.

Analyses was done, and no significant associations were found between Autoimmune Disorder and

Type of living area
Type of diet,
average amount of daily exercise and
if the dog had had a viral illness.

16 dogs had a loss of pigmentation, of these 6 had Autoimmune disorder, but due to the low numbers no further analysis could be done.

Due to the lack of number of individuals with Autoimmune disorder and their distribution within the vaccination routines, no analysis could be done to investigate any association between the two.

Hypothyroidism

18 dogs were reported as having hypothyroidism (8 male, 10 female). Analysis revealed no significant association between hypothyroidism and Total Sound Sensitivity; nor with Total Friendliness Score, but this may simply reflect the high friendliness scores of the sample. There was insufficient data to test against Nervousness Score.

Cushings

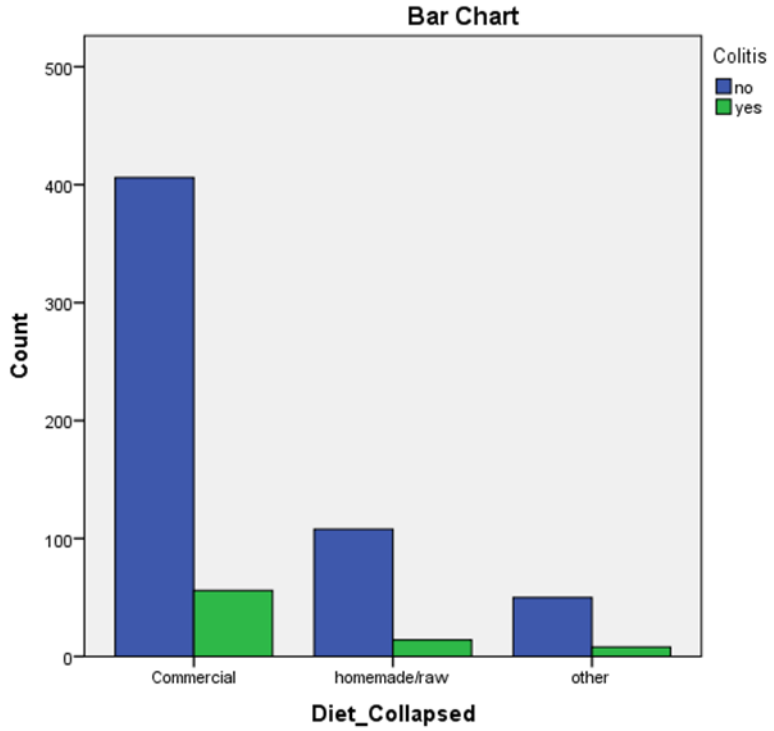
7 dogs were reported as having Cushings (2 male, 5 female), of these only 1 female was also reported as having loss of pigment.

Colitis

23 males (21 entire, 13 neutered) and 43 females (20 entire, 23 spayed) were reported as having had colitis.

There was no significant association between colitis and current age, nor with diet (see Figure 11). Due to too few data no analysis of colitis and nervousness could be conducted.

Figure 11 Diet by dogs recorded as having had colitis.



Behaviour

Nervousness

604 owners considered they could rate their dog's nervousness, 60% (362) were considered not nervous, and 9% (55) were considered to show nervous behaviour often or always.

Table 8: owner rating of nervousness by gender

	All dogs	Male	Female	Male entire	Male neutered	Female entire	Female spayed
Never / rarely	362	157	205	124	33	116	89
Sometimes	187	101	86	42	29	42	44
Often / always	55	35	20	17	18	5	15
total	604	293	311				

Friendliness

The mean friendliness score was 4.39 (s.d. = 0.8, n = 578), where 5 is always friendly. Table 9 shows there were no differences across gender in owner rating of friendliness. There was no relationship between age of dog and friendliness score.

Table 9: Friendliness score by gender

	Male entire	Male neutered	Female entire	Female spayed
Mean Score	4.46	4.39	4.49	4.2
S.D.	0.74	0.69	0.77	0.89
n	184	82	166	143

Breeding and Scoring for Hip, Elbow and Eye Problems

Respondents whose dogs had been bred from were asked if they had been scored for hip, elbow and eye problems. Not all responded, but of those that did the frequency of type of test done is given in Table 10

Table 10: numbers of breeding dogs tested for Hip or Elbow Dysplasia or Eye problems

	Hip Yes	Hip No	Elbow Yes	Elbow No	Eye Yes	Eye No
Male	44	6	0	50	23	27
Female	120	14	6	129	61	73

Discussion

This survey was of an ambitious design and was responded to well, with data collected for 700 dogs (511 alive, 188 dead, 1 unknown) registered with the UK Kennel Club (UKKC), a number comparable to that of the Kennel Club 2004 survey which represented 563 live dogs and 278 reported dead dogs.

39.45% of the current sample of 188 dead dogs had died of old age compared to 25.9% in the UKKC survey. 57.5% had died of a medical condition, comparable to the UKKC survey which recorded 62% deaths through named conditions. The difference in figures may reflect advances in nutrition and veterinary care, or reflect a sample bias.

75.29% (n=527) dogs in the sample reported at least one illness, not including parasitic infection. As dogs could have more than one illness data relates to the number of reports (NR) of an illness, rather than the number of dogs. Most commonly reported problems were dental (NR =281), musculo-skeletal (NR=188) and infections (NR = 171, all were kennel cough). Given that there is a vaccination for kennel cough, this latter figure may be considered to be a rather high level of incidence, and perhaps owners should be encouraged to vaccinate for this.

Musculo-skeletal problems were varied and whilst there were significant associations with age of neutering in males (p=0.05) and osteoarthritis; and average amount of daily exercise and general musculo-skeletal problems (p=0.027) in females, these were weak and do not give evidence of causality.

Only 9 incidents of hip and 2 of elbow dysplasia were recorded, which is encouraging. Testing for hip dysplasia is currently advised in all UK Bearded Collie Clubs codes of ethics, especially if the dog is to be bred from. In the sample, 134 bitches and 50 males had been used for breeding. Thus it was disconcerting to note that 6 breeding males and 14 breeding bitches had not been hip scored. Elbow

dysplasia is also likely to have a genetic basis, yet only 6 breeding bitches had been tested and no males.

Not all respondents answered these questions, so in fact there may be more dogs with hip and elbow issues that are contributing to the breed gene pool.

As with hearing issues, reduction in sight is detrimental to welfare and can increase behaviour issues such as nervousness and aggressive incidents as the dog's sensory acuity is compromised and it is more like to startle. Some sight problems are also inherited such as Progressive Retinal Atrophy, Congenital Eye Anomaly/ choroidal hypoplasia (CEA/CH) (UFAW 2015). Whilst there were no cases of PRA in the sample, one case of CEA/CH was recorded. It is encouraging therefore that approximately half of the breeding bitches and males had been tested for eye problems, though the age at which they were tested is unknown. These would most likely have been visual tests as, at the time of the survey, DNA testing was not considered necessary. Some conditions will only be detected by visual examination if it is conducted in puppies, but this may not pick up all those affected and will not pick up carriers. Thus, it is strongly recommended that puppy testing occurs ***and*** that ***all*** breeding animals are DNA tested for CEA/CH to detect carriers. In such cases where both parents have tested (DNA) as clear, then their puppies will also be clear. Regular testing, annually, for breeding dogs and bitches is recommended to detect any later developing conditions that may be heritable.

Whilst it has long been known that nervousness is heritable (Goddard and Beilharz, 1985), nervousness and aggression have been linked to hypothyroidism in a variety of breeds, including the Bearded Collie (Hamilton Andrews, 1998). In the current study, too few (n=18) dogs were reported as suffering from this condition for any further analysis to be considered. Causes of hypothyroidism are unclear, but it may have a genetic link and, in some forms, be of an autoimmune nature (Kennedy et al. 2006). Thus, it is advisable that dogs diagnosed with hypothyroidism are not bred from.

Overall 72 (10.3%) of the current sample of dogs were recorded as having at least one autoimmune disorder, with Rheumatoid Arthritis the most prevalent, followed by Addison's Disease, SLO and AIHA. Further, most owners did not know if relatives of their dog had autoimmune disorder, and even those who reported that no relatives had autoimmune disorder may not be correct. Given there is no mandatory reporting of autoimmune disorders back to breeders, or the KC, it is unlikely that the "No" response is a true reflection of the situation, especially as some dogs will have been sold as pets, and traceability lost. However, this does show the participants' perception of the breed.

Whilst research into canine autoimmune disorders is being conducted, including within the Bearded Collie, the causes and modes of genetic inheritance remain unclear (Lohi et al 2010; Sell 2011). This highlights the need for a cautious approach to be undertaken in order to avoid further spread. This is underscored as there is no test yet available to detect carriers. Future research into the distribution of haplotypes in the Major Histocompatibility Complex (MHC) may shed further light on the likelihood of inheriting an AI condition (Fernando et al. 2008; Goodman 2010).

Thus, it is accepted wisdom that if a dog or bitch has an autoimmune condition or has close relatives with autoimmune disorder they should not be bred from (www.canismajor.com). Further, if a mating produces puppies that develop an autoimmune condition the mating should not be repeated(Kershaw, pers comm, accredited to Animal Health Trust n.d.). Along with this advice

breeders should avoid close inbreeding and the overuse of popular sires in order to avoid the inheritance of homozygous genes that may contribute to Autoimmune problems and to slow down the loss of further genetic diversity within the breed as whole.

Whilst the data has provided a snapshot of the health of Bearded Collies owned in the UK in the calendar years 2007-2011, the study has limitations. As with all questionnaire surveys the benefits of low cost data collection need to be reconciled with issues of low response rates, recall bias and an inability to verify and validate the data. As O'Neill and colleagues (2014) clearly state this is of importance in health surveillance research. It is thus strongly advised that the Bearded Collie Clubs actively promote and work with the VetCompass Surveillance System which collects and studies primary-care veterinary clinical data.

This results of the study has identified a cautious approach as being the most appropriate for the maintenance and improvement of health of the breed overall, and the welfare of individual dogs. It is both a legal and ethical duty for those responsible for the breed's health to take all reasonable steps to ensure dog welfare is met. This may mean that current advice / guidelines regarding testing and breeding should be made mandatory, and that breeders, current, future and potential owners are made aware of health issues within the breed.

Author contributions: Elizabeth Kershaw was the Bearded Collie Health Coordinator UK Bearded Collie Breed Liaison Committee until December 2014 and was responsible for the inception of the study and detailed content of the questionnaire, in consultation with the members of the Bearded Collie Breed Liaison Committee. Anne McBride contributed advice to the development of the questionnaire, processing ethical approval and hosting of the survey, and was responsible for the main writing up of the report. Abbie Wilkins conducted the analysis of the data.

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