



Web: <https://vprf.wordpress.com>

Twitter: @Vet_Policy

E-mail: ridgea@parliament.uk

Conformation related diseases

Fact File

Authors:

Rachel Hopper
MSc

Anthony Ridge
MA(Zoology) VetMB MRCVS

Professor the Lord Trees
BVM&S, PhD, DVetMed (hc), DVMS,
MRCVS, Hon FRSE

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About the Veterinary Policy Research Foundation (VPRF)

The VPRF is a not-for-profit organisation set up by Lord Trees with the purpose of employing a veterinary surgeon as an intern/researcher to facilitate Lord Trees' activities in the House of Lords. The current intern is Anthony Ridge. The VPRF is funded by donations from several veterinary organisations, professional bodies and universities. Further information on the VPRF can be found on our website: <https://vprf.wordpress.com/>

About the Authors

Rachel Hopper, the primary author of this fact file, is a biologist and PhD student at the Liverpool School of Tropical Medicine. This fact file was created during a six week placement with Lord Trees and Anthony Ridge in June/July 2017.

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Aims and Objectives

The purpose of this fact file is to provide an unbiased and factual summary of mainly quantitative information relating to animal conformation related disorders.

Whilst conformation related diseases are found in a wide range of animals including domestic livestock, this fact file is primarily focused on companion animal conformational disorders.

We have **not** attempted a comprehensive review or analysis of research as such a task is beyond our current resources. The authors aim to update this report as new relevant information becomes available. The date of the latest update is displayed on the cover page. The authors welcome any constructive feedback on additional data to include or ways to further improve this document. These will be considered in future updates.

1. Introduction

The conformation of an animal is its physical shape and proportionate dimensions (Merriam-Webster)

Domestic animals have been selectively bred for centuries and there is evidence of the existence of domestic dogs over 15,000 years ago (Larson and Bradley 2014). Selective breeding has resulted in the creation of large numbers of domestic animal breeds of differing conformational characteristics. This is particularly notable in dogs where in the UK there are currently 218 officially recognised breeds with enormous variations in conformation (Kennel Club)

Certain types of exaggerated conformational characteristics are associated with diseases which compromise the welfare of animals (see below).

1.1. List of dog breed conformational diseases

- Musculoskeletal – hip/elbow dysplasia in large breeds due to a larger body mass; patella luxation in very small breeds; Legg Calve- Perthe in dogs with short legs; small head size in relation to the brain can cause Chiari malformation and syringomyelia; brachycephalia; anal furunculosis from low tail carriage; spina bifida in screw tail breeds.
- Gastrointestinal – gastric torsion in deep chested breeds.
- Respiratory – brachycephalia in short-headed dogs; tracheal collapse in miniaturisation of breeds
- Urogenital – Dystochia caused by large heads and comparatively small pelvises; urate urolithiasis.
- Skin – excessive skin folds causing dermatitis and pyoderma; otitis externa caused by skin infections and often worsened by pendulous ears; entropion and ectropion are eyelid disorders causing irritation or the eye to be exposed; dermoid sinus from the skin and neural tube not separating properly in development
- Nervous-Sensory – ulceration/irritation of the eye in dogs with protruding eyes resulting from a lack of tear production or inadequate blinking due to the eyelids being so far apart; deafness linked with coat colour or pattern; cranioschisis in dogs with dome shaped head; cervical disk disease in dogs with heavy heads and long necks; intervertebral disc disease

Source: www.dogbreedhealth.com

2. Brachycephaly

2.1. Introduction

In humans, brachycephaly is a term used to describe a congenital malformation resulting in a disproportionately short and broad skull (Mosby's Medical Dictionary, 2009). Through selective breeding the skeletal muzzle length of some dog and cat breeds has been reduced. The skeletal conformation combined with the relatively large size of the remaining soft tissues of the are associated with a wide range of health problems include diseases of the upper airways, eyes, ears and skin as well as gastro-intestinal and reproductive tracts.

2.2. Common conditions affecting brachycephalic dogs

- **Brachycephalic Obstructive Airway Syndrome (BOAS)** is the name for the respiratory related disease and is caused by several abnormalities. These include stenotic nares (narrowed nostrils), a long soft palate, tracheal hypoplasia and enlarged tonsils. These are observed through a variety of symptoms including difficulty breathing, snoring, panting, over-heating and exercise intolerance.
- The abnormalities result in an increased inspiratory effort and negative airway pressures which lead to oedema, stretching of the soft tissues of the airway and eventually collapse of the cartilage of the larynx.
- **Brachycephalic Ocular Syndrome** is the term for the disease affecting brachycephalic animals which often combines lesions of the eyelid, conjunctiva and cornea.
- **Dystocia** is the term given to describe difficulties in giving birth. Dystocia is common in brachycephalic breeds due to the puppies have relatively large heads compared to the relatively narrow pelvis of the mother.
- **Skin Fold Dermatitis** is the irritation of the skin between folds. This is common in the faces of brachycephalic breeds as the amount of skin which covers the shortened muzzle is not proportionally reduced.

2.3. List of brachycephalic dogs

There are many brachycephalic breeds of dog in the UK. A list of brachycephalic dogs produced by corporate vet group CVS and published in the [Veterinary Record \(27/05/17\)](#) included:

- Affenpinscher
- American Staffordshire terrier
- American Bulldog
- Boston terrier
- Boxer
- Brussels griffon
- English Bulldog
- Bullmastiff
- Cane Corso
- Chihuahua ("apple headed")
- Chow Chow
- Dogo Argentino
- Dogue de Bordeaux
- English Mastiff
- French Bulldog
- Japanese Chin
- King Charles spaniel (not Cavalier)
- Neapolitan mastiff
- Newfoundland
- Pekingese
- Presa Canario
- Pug
- Shar Pei
- Tibetan Special

Others breeds in which brachycephaly may be found include: Cavalier King Charles Spaniel, Lhasa Apso, Pomeranian, Rottweiler and Shih Tzu

2.4. Brachycephalic breed registrations per year

French Bulldogs are currently the most popular brachycephalic breed in the UK, and are predicted to become the most popular dog breed in the UK by the end 2018, overtaking both the Cocker Spaniel and the Labrador retriever (KC press release, 2017). French Bulldog registrations have increased from 692 in 2007, to 21,470 in 2016, with a 368% rise in the last five years (Figure 1). The second most popular brachycephalic breed is the Pug, increasing from 3547 in 2007 to 10,408 in 2016, followed by the English Bulldog with 7,785 registrations in 2016.

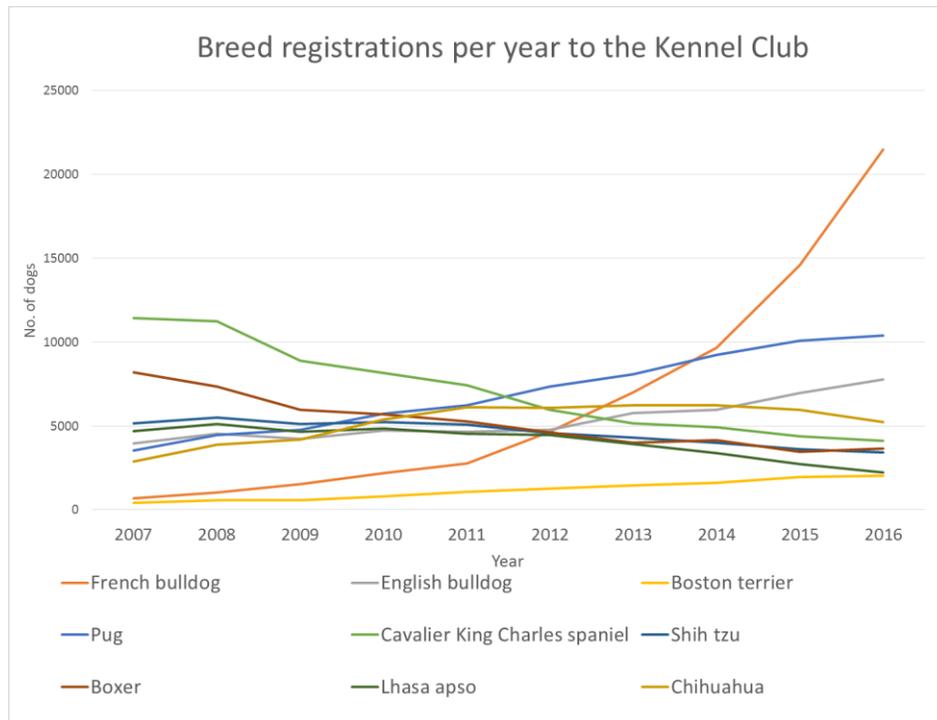


FIGURE 1: BREEDS SELECTED WHICH HAD MORE THAN 2,000 REGISTRATIONS IN 2016. LIMITATIONS OF THE DATA INCLUDE THE FACT THAT CROSS BREDS ARE NOT INCLUDED AND THAT REGISTRATION IS NOT COMPULSORY.

2.4.1. Reasons for increase in popularity

A recent study carried out by the Royal Veterinary College and Plymouth University (Packer *et al.* 2017) highlights the reasons why owners would purchase a brachycephalic dog. Appearance of the dog was found to be the most common reason for purchase, with their baby-like features often quoted as being attractive. It was also found that owners of brachycephalic dogs were more likely to live in apartments, and therefore the small size of the breeds was said to be a factor. Owners of these breeds are also younger, and the authors suggest that the media may have been influential with brachycephalic breeds being used more frequently in advertising.

2.5. Brachycephalic related health problems for popular breeds

Different breeds may be more or less affected by brachycephaly, and different associated conditions may be present in some breeds and not others. Below is a summary of the conditions affecting breeds which are both popular in the UK and most affected with brachycephalic conditions.

2.5.1. Upper respiratory tract/BOAS studies

O'Neill *et al.* (2015) analysed data collected as part of the VetCompass programme to investigate the relationship between brachycephaly and upper respiratory tract (URT) disorders. The sampling frame included all dogs attending a practice within the Medivet Veterinary Partnership between September 2009 and March 2014. Stratified random sampling was performed to select two hundred dogs from each of six breed types. Three extremely brachycephalic breed types (English Bulldog, French Bulldog and Pug) were compared with one moderately brachycephalic breed (Yorkshire Terrier) and two non-brachycephalic breeds (Border Terrier and West Highland White Terrier) (Table 1 & Figure 2).

- The Pug had the highest prevalence of BOAS at 6.5%, with 26.5% of the Pugs sampled having at least one URT disorder.
- The English and French Bulldogs had a BOAS prevalence of 2.5% and 1.5% respectively, with 19.5% and 20.0% having at least one URT disorder.
- No cases of BOAS were detected in the moderately or non-brachycephalic breeds
- For the non-brachycephalic breeds, the proportion of dogs with at least one URT disorder was **less than half** of that for the extremely brachycephalic breed types.

Variable	English Bulldog (n=200)	French Bulldog (n=200)	Pug (n=200)	Yorkshire Terrier (n=200)	Border Terrier (n=200)	West Highland White Terrier (n=200)
At least one URT disorder	19.5%	20.0%	26.5%	13.0%	9.0%	7.0%
Disorder of the nares/nasal cavity	7.5%	12.0%	14.5%	4.0%	4.0%	3.5%
Disorder of the hard and soft palate	2.5%	3.0%	4.0%	0.0%	0.0%	0.0%
Disorder of the pharynx	1.0%	1.0%	2.0%	0.5%	0.5%	1.0%
Disorder of the tonsil	0.0%	1.5%	0.0%	0.5%	0.0%	0.0%
Disorder of the larynx	0.5%	1.5%	1.5%	0.0%	0.5%	0.0%
Disorder of the Trachea	3.5%	6.0%	5.5%	10.0%	5.0%	4.0%
BOAS	2.5%	1.5%	6.5%	0.0%	0.0%	0.0%
Multi-site URT	10.5%	10.5%	13.0%	2.0%	2.5%	1.0%

TABLE 1: PREVALENCE OF UPPER RESPIRATORY TRACT DISORDERS AMONG EXTREMELY, MODERATELY AND NON-BRACHYCEPHALIC DOGS. ADAPTED FROM O'NEILL ET AL. (2015)

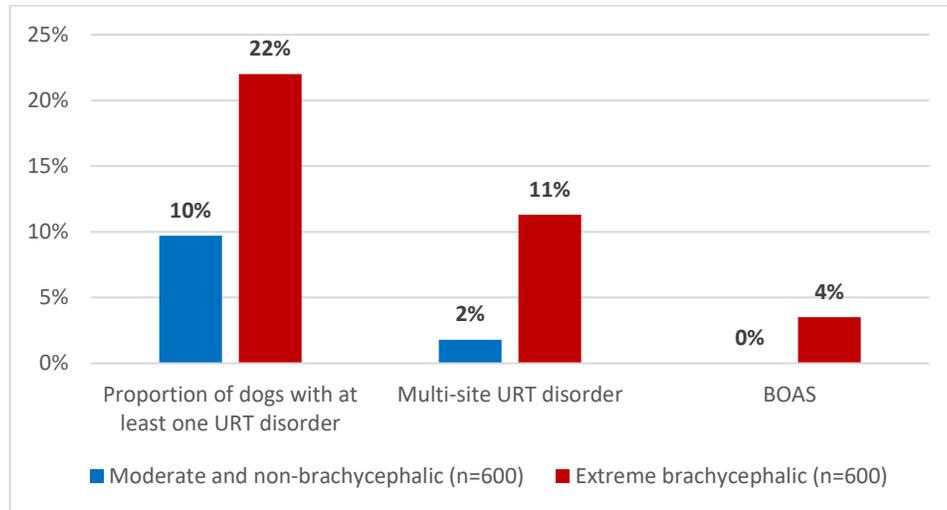


FIGURE 2: SUMMARY OF EXTREME BRACHYCEPHALIC BREEDS COMPARED AGAINST THE MODERATE AND NON-BRACHYCEPHALIC BREEDS. P-VALUES FOR EACH VARIABLE ARE ALL <0.001. ADAPTED FROM O’NEILL ET AL. (2015)

Packer *et al.* (2015) recruited dogs of any breed entering the Royal Veterinary College Small Animal Referral Hospital for any condition to investigate the relationship between facial conformation and BOAS. 700 dogs were recruited from 97 breeds, twelve of these breeds were found to be affected by BOAS, and of those breeds the proportion of dogs within the breed who were affected by BOAS is shown in Table 2.

- The Pug breed was found to have the highest proportion of affected dogs with 88%
- The French Bulldog had the third highest proportion at 70%, after the Boston Terrier at 83%
- The English Bulldog was sixth with 63%
- Sample sizes for several of the breeds were small

Breed	Pug (n=32)	French Bulldog (n=13)	English Bulldog (n=16)	Boston Terrier (n=6)	Pekingese (n=3)	Dogue de Bordeaux (n=6)	Griffon Bruxellois (n=2)
Affected (%)	88%	70%	63%	83%	67%	67%	50%
Breed	Boxer (n=13)	Shih Tzu (n=13)	Chihuahua (n=5)	CKCS (n=26)	Affenpinscher (n=1)	Staffordshire Bull Terrier (n=16)	
Affected (%)	18%	8%	40%	4%	0%	6%	

TABLE 2: PROPORTION OF DOGS WITHIN SELECTED BREEDS WHICH ARE AFFECTED BY BOAS. ADAPTED FROM PACKER ET AL. (2015).

2.5.2. Dystocia

Evans & Adams (2010) analysed data from the 2004 Kennel Club Purebred Dog Health Survey to calculate the frequency of caesarean section by breed. The frequency of caesarean sections was estimated as the proportion of litters born by caesarean section. The percentage of caesareans for four brachycephalic breeds are shown in comparison with four non-brachycephalic breeds (Table 3).

Breed	No. of litters	Percentage caesarean (%)
Boston Terrier	52	92.3%
English Bulldog	288	86.1%
French Bulldog	80	81.3%
Pug	223	27.4%
Beagle	312	21.2%
Border Collie	227	10.6%
English Springer Spaniel	195	10.3%
Labrador Retriever	866	20.2%

TABLE 3: BRACHYCEPHALIC BREED CAESAREAN RATES FOR THE BOSTON TERRIER, ENGLISH BULLDOG, FRENCH BULLDOG AND PUG ARE COMPARED WITH RATES FROM FOUR NON-BRACHYCEPHALIC BREEDS: BEAGLE, BORDER COLLIE, ENGLISH SPRINGER SPANIEL AND LABRADOR RETRIEVER.

2.5.3. Corneal ulcerative disease

The VetCompass Programme data was also used to examine the prevalence of corneal ulcerative disease (CUD) in dogs (O'Neil *et al.*, 2017). The sampling frame included 104,233 dogs which had attended 110 different primary care practices enrolled in the VetCompass Programme. The Pug was found to have the highest prevalence of CUD, followed by the Boxer and Shih Tzu (Table 4). When compared with the prevalence in crossbred dogs, the Pug was 19 times more likely, the Boxer 12 times more likely, the French Bulldog 7 times more likely and brachycephalic breeds (grouped including American Bulldog, Boston Terrier, Boxer, English Bulldog, French Bulldog, Pekingese, Pug and Shih Tzu) were 11 times more likely to suffer from CUD.

Breed	No. of dogs in study	Prevalence (%) of CUD
Pug	1015	5.42%
Boxer	1386	4.98%
Shih Tzu	2031	3.45%
Cavalier King Charles Spaniel	2332	2.49%
English Bulldog	787	2.41%
King Charles Spaniel	496	2.22%
Lhasa Apso	892	2.13%
French Bulldog	642	1.87%
Border Collie	2807	0.43%
Crossbreed	23329	0.38%
Labrador retriever	9541	0.25%

TABLE 4: THE PREVALENCE OF CORNEAL ULCERATIVE DISEASE IN A SELECTION OF BRACHYCEPHALIC AND NON-BRACHYCEPHALIC DOG BREEDS. ADAPTED FROM O'NEIL ET AL. (2017).

2.6. Brachycephalic related diseases reported by breed

2.6.1. French Bulldog

- The Kennel Club Pedigree Health Survey 2014 was sent to all KC registered dog owners, and was promoted out to the general dog owning population. There were 330 responses about living French Bulldogs. BOAS was the second most common condition recorded (after allergic skin disease) with a prevalence of **4.85%**.

- In a study by Liu *et al.* 2015, 90% of the French Bulldogs studied had at least a partial restriction of their airways (n=89 (19 referred from Queen’s Veterinary School Hospital for BOAS consultation and 70 volunteered by UK owners).

Other brachycephalic related conditions commonly found in this breed include:

- Dystocia – Evans & Adams (2010) found the French Bulldog had an 81.3% caesarean rate (n=80).

2.6.2. English Bulldog

- The Kennel Club Pedigree Health Survey 2014 received responses about 370 living English Bulldogs. BOAS was the tenth most common recorded condition with a prevalence of 2.43%.

Other common brachycephalic related common conditions include:

- Brachycephalic Ocular Syndrome
- Dystocia due to Foetal-Pelvic Disproportion – Evans & Adams (2010) found the English Bulldog had an 86.1% caesarean rate (n=288).

2.6.3. Pug

- The Kennel Club Pedigree Health Survey 2014 received responses about 555 Pugs. BOAS was the twelfth most common recorded condition with a prevalence of 2.16%.

Other brachycephalic related common conditions include:

- Brachycephalic Ocular Syndrome
- Skin Fold Dermatitis

2.6.4. Boston Terrier

Other common brachycephalic related disorders include:

- Dystocia – Evans & Adams (2010) found Boston Terriers had a 92.3% caesarean rate (n=52).

2.6.5. Shih Tzu

Other common brachycephalic related disorders include:

- Brachycephalic Ocular Syndrome
- Keratoconjunctivitis Sicca

2.6.6. Cavalier King Charles spaniel

Other common brachycephalic related disorders include:

- Primary Secretory Otitis Media

2.7. Owner perceptions of brachycephalic breeds

Packer *et al.* (2012) used a questionnaire-based survey to investigate whether owners identified the clinical signs of BOAS as a veterinary problem. **Over half (58%) of owners which had dogs which were actually affected (confirmed by examination) reported that their dogs had no breathing problems.** This may be due to a perception of noisy breathing or other related symptoms being ‘normal’ for the breed. Therefore any studies (such as the KC Pedigree Health Survey 2014) where results are owner-reported should be viewed with a degree of uncertainty.

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3. Intervertebral Disc Disease

3.1. Introduction

Intervertebral disc disease is an age-related, degenerative condition of the intervertebral discs. The degeneration results in reduced shock absorbance which causes disc herniation and spinal cord compression. This causes pain, and can eventually lead to the loss of the ability to walk. In severe cases dogs may experience paralysis, loss of bladder control and loss of pain sensations (American College of Veterinary Surgeons).

3.2. Types of Intervertebral Disc Disease:

- Hansen type I disc degeneration occurs due to a loss of notochordal cells, which are responsible for producing proteoglycans which “hold water” in the disc. The inner contents of the intervertebral disc suffer an extrusion. This is the type which is most common in small breed dogs with disproportionately short limbs (Rusbridge, 2015).
- Hansen type II is more common in medium to large breed dogs and is more similar to that of a human disc disease. This occurs when the outer part of the disc bulges and protrudes.
- Hansen type III is an injury caused by a sudden trauma, and does not result in a progressive or on-going spinal cord compression and will likely recover with non-invasive treatments such as physiotherapy.

3.3. IDD prevalence

The incidence of IDD for all breeds was calculated as **23 cases per 1000** dogs per year in a study of 13 North American Veterinary Schools, with the Dachshund, Pekingese, Beagle, Welsh Corgi, Lhasa Apso, and Shih Tzu at a significantly increased risk. The prevalence in a Dachshund breed is predicted to be around **19%** (Priester, 1976).

A study in Finland (Lappalainen *et al.*, 2014) detected an **IDD overall prevalence of 31% for all Dachshund types** (n=193). All dogs recruited were over ten years old and had been radiographed for intervertebral disc calcifications (IDC) for screening purposes as per the Finnish Dachshund Club protocol. The miniature wire-haired had the highest prevalence at 50.0% (n=30) and the standard long-haired had the lowest at 13.3% (n=38). The most popular UK Dachshund breed – the miniature smooth haired, had a prevalence of 33.3%.

Breed variant	Dogs (n)	IDD%
Standard wire-haired	63	28.6%
Miniature wire-haired	30	50.0%
Standard smooth-haired	26	26.9%
Miniature smooth-haired	6	33.3%
Standard long-haired	30	13.3%
Miniature long-haired	38	34.2%

TABLE 5: DACHSUND BREED VARIANTS AND THE PREVALENCE OF IDD. ADAPTED FROM LAPPALAINEN ET AL. (2014)

The 2014 Kennel Club Pedigree Breed Health Survey reported prevalence of IDD for the following breeds of dog:

Dog breed type	n	Prevalence (5)%
Dachshund Wire-haired	94	3.19%
Dachshund Smooth-haired	43	2.33%
Dachshund Miniature wire-haired	146	8.90%
Dachshund Miniature smooth-haired	296	10.14%
Dachshund Miniature long-haired	168	2.98%
Pekingese	45	2.22%
Shih Tzu	350	2%
Welsh corgi (Pembroke)	96	1.04%
Welsh corgi (cardigan)	45	Not given, but most common condition listed for breed

TABLE 6: PREVALENCE OF INTERVERTEBRAL DISC DISEASE IN DIFFERENT TYPES OF DACHSHUND FROM THE 2014 KENNEL CLUB PEDIGREE BREED HEALTH SURVEY. DACHSHUND (LONG-HAIRED) DID NOT HAVE IVD LISTED UNDER THE MOST COMMONLY REPORTED DISEASE CONDITIONS

3.4. Increase in Dachshund popularity

There are several different types of Dachshund registered in the UK. These are:

- Standard long-haired
- Miniature smooth-haired
- Miniature long-haired
- Miniature wire-haired
- Standard wire-haired
- Standard smooth-haired

The total number of Dachshund breed dogs registered with the Kennel Club has risen from 4,902 in 2007, to 7,165 in 2016 (figure 1). This overall increase is largely due to the numbers of miniature smooth-haired Dachshunds increasing from 2,112 in 2007, to 4,576 in 2016.

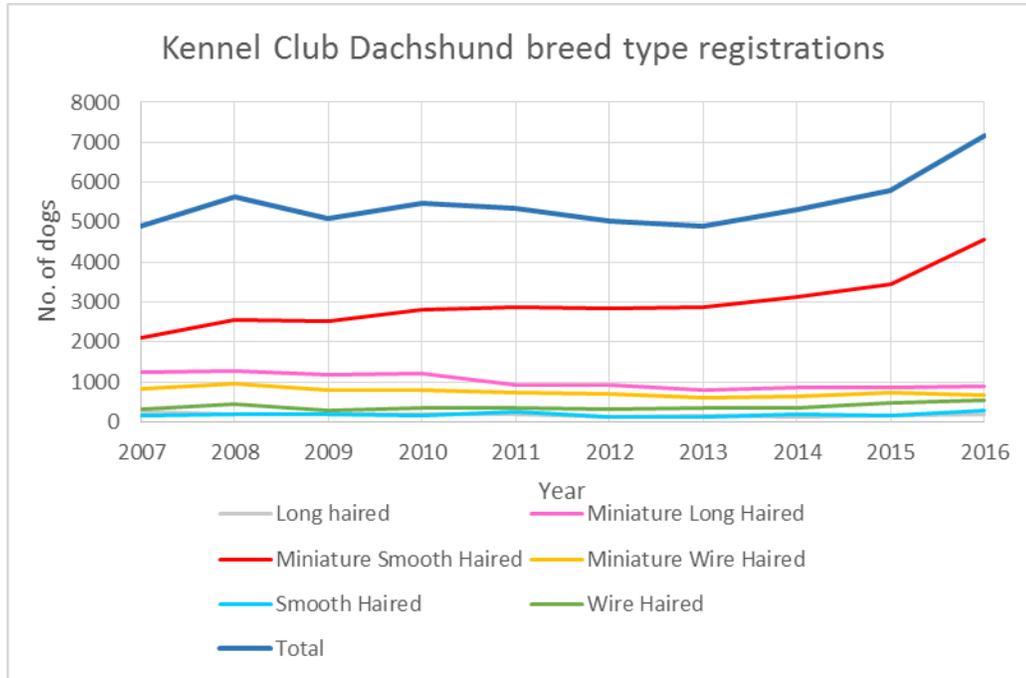


FIGURE 3: NUMBERS OF DACHSHUND DOGS REGISTERED WITH THE KENNEL CLUB FROM 2007 TO 2016. SEPERATED BY TYPE WITH THE TOTAL NUMBERS GIVEN BY THE DARK BLUE LINE.

3.5. References

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4. Osteochondrodysplasia/Scottish fold cats

4.1. Introduction

Osteochondrodysplasias categorises a group of disorders which cause compromised cartilage and/or bone growth resulting in a deformed skeleton. In Scottish fold cats it results from a genetic abnormality causing the characteristic folded ear shape as well as malformations in the distal forelimbs, distal hind limbs and tail. Cats which have two copies of the abnormal gene develop a worsening crippling arthritis whilst young, and cats with one gene still develop arthritis, but it worsens at a slower rate. All folded-ear cats will develop osteochondrodysplasia to some degree. The pattern of inheritance is incomplete dominant, and even heterozygous folded ear cats should not be used for breeding (Takanosu *et al.*, 2008).

4.2. Registration of Scottish fold cats

It is because of these health concerns that the UK pedigree cat registry, the Governing Council of the Cat Fancy, stopped registering folds by 1971, only five years after it began accepting registrations. The international Feline Federation will also not recognise this breed due to its health conditions. Due to the lack of registration, there is no accurate data on Scottish fold numbers, however numbers are reported to be increasing in the United States, Turkey (Aydin *et al.*, 2015) and Japan to name a few.

4.3. Popularity of Scottish fold cats

Their popularity is due to their round faces and expressions making them an attractive breed. There are also several celebrity owners who will share images on social media to their millions of fans, without any mention of their inevitable declining health. The owner of a Scottish fold cat in Japan, known as Maru, has videos on youtube which have been watched more than 300 million times (BBC, 2017).

4.4. Evidence of disease

Literature is limited for this condition in Scottish fold cats but several small scale studies have examined the effect of the disease. A study by Aydin *et al.*, (2015) examined 11 Scottish fold cats in hope to raise awareness of the condition. Cats were recruited as they were brought to the Istanbul University Veterinary Faculty with clinical signs suspected to be caused by osteochondrodysplasia:

- 8/11 cats (aged 5 months – 2 years) were reported by their owners to be reluctant to move and gave a pain response whilst being manipulated.
- The other three cats were not reported by their owner to have muscular complaints until several days prior to their appointments. Physical examination of these cats found difficulties in walking as well as bilateral, painful, hard masses.
- 2/11 cases showed deformation of the forelegs and metacarpal bones
- All cases showed deformation and pain in the distal extremities
- The majority of owners were unaware of the disease

4.5. Potential for a ban?

There is currently no breeding ban on the Scottish fold cat, but the Scottish government is reportedly considering one. A BVA article (11/05/2017) addressed the announcement by the Cabinet Secretary for Environment, Climate Change and Land Reform Roseanna Cunningham MSP which included the introduction of controls to restrict the use of electronic training collars and a commitment to update regulations to combat

the irresponsible breeding and sale of dogs, cats and rabbits. ‘Gudrun Ravetz, British Veterinary Association President, added, “Animal welfare starts right at the beginning of a pet’s life, so the focus on pet licensing and breeding regulations is welcome. We know that a third of vets are seeing puppies they believe to have been illegally imported and an increasing number of owners are buying brachycephalic or designer breeds, like Scottish fold cats; pets must be purchased with owners prioritising animal health and welfare, rather than making an impulse buy based on looks alone.’

4.6. References

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