

Pug health using VetCompass 'big data'

Dan O'Neill MVB BSc(hons) GPCert(SAP) GPCert(FelP) GPCert(Derm) GPCert(B&PS) MSc(VetEpi) MRCVS, Veterinary Epidemiology and Public Health, The Royal Veterinary College, UK, discusses recent research on the demography and common disorders of the general population of Pugs under veterinary care in England. These results are likely to be mirrored in Ireland

The Pug is an ancient dog breed that has now become very popular. However, Pugs are reported as predisposed to ocular, respiratory and dermatological problems. The VetCompass Programme collates de-identified clinical data from primary-care veterinary practices for epidemiological research. Using VetCompass clinical data, this study explores the demography and common disorders of the general population of Pugs under veterinary care in England. It is likely that these results mirror the situation in Ireland. Pugs rose from comprising less than 1% of annual birth cohorts before 2008 to comprise 2.8% of the 2013 annual birth cohort and 68.2% of Pugs had at least one disorder recorded during 2013. The most prevalent disorders recorded overall were overweight/obesity (13.18%), corneal disorder (8.72%) and otitis externa (7.53%). The most prevalent disorder groups were ophthalmological (16.25%) and dermatological (15.60%). Ownership of Pugs in England is rising steeply. Higher levels of overweight/obesity and corneal disorders compared with other breeds suggests that these conditions are health priorities for the breed and provides an evidence-base for reforms to improve health and welfare within the breed.



Figure 1: Pug. Photo: The Kennel Club.

THE BACKGROUND

The Pug (see Figure 1) is an ancient breed of Chinese origin with references to 'short-mouthed' Pug-type dogs documented by Confucius as early as 551 BC.^{1,2} The Pug name derives from the Latin word *pugnis* meaning fist, because the side profile of the Pug head resembled the shape of a closed fist.^{1,2} Annual UK Kennel Club registration data highlight a dramatic increase in Pug registrations over

the past decade, rising over four-fold from 2,116 registrations in 2005 to 9,245 registrations in 2014 when the Pug was the fifth most commonly registered breed after the Labrador Retriever, Cocker Spaniel, English Springer Spaniel and French Bulldog.³ However, despite (or perhaps because of) their popularity, several health problems have been reported in Pugs⁴ that paradoxically may be associated with conformational characteristics that also make the Pug fashionable as a breed such as wide, prominent eyes and short muzzles.⁵⁻⁷ In recognition of these breed challenges, the UK Kennel Club lists the Pug as a category 3 breed (the highest category) in its 'Breed Watch' system with particular points of concern including 'difficulty breathing, excessive nasal folds, excessively prominent eyes, incomplete blink, sore eyes due to damage or poor eyelid conformation, signs of dermatitis in skin folds, significantly overweight, and unsound movement'.⁸ Up-to-date and reliable evidence on the true disorder burden of Pugs in the UK is essential to provide an evidence base for reforms in breeding practices to improve the health and welfare of these popular dogs.

THE DATA

Research using veterinary primary-care clinical data benefits from greater generalisability and reduced selection and recall biases compared with other data sources such as questionnaire, referral or pet insurance data.⁹ The VetCompass Programme¹⁰ harvests anonymised clinical record data that primary-care veterinary practices already record and use these for epidemiological research.¹¹ Information collected included patient demographic (species, breed, date of birth, sex, neuter status, colour, insurance status and bodyweight) and clinical information (free-form text clinical notes, VeNom summary diagnosis terms¹² and treatment, with relevant dates) data fields. To date, over 500 (>10%) of UK vet practices collaborate within VetCompass, sharing clinical data on six million animals, 36 million episodes of care and 110 million treatments. Analysis of VetCompass Big Data is now giving insights from the primary-care veterinary world that were previously unthinkable.¹³

THE RESULTS

DEMOGRAPHY

Demography was explored for all dogs with at least one clinical record (under veterinary care) from September 1, 2009 to April 30, 2015. Pugs comprised 2,695 (1.02%) of the overall 263,456 dogs. Annual proportional birth rates showed that Pugs rose sharply from less than 1% of the pre-2008 annual

VetCompass birth cohorts to comprise 2.8% of the annual birth cohort born in 2013 (see Figure 2).

Bodyweight growth curves were generated using 4,075 bodyweight-date values of 922 male Pugs and 3,062 bodyweight-date values of 772 female Pugs that had at least one bodyweight value recorded. These bodyweight growth

As diagnosed disorder	Disorder Count	Prevalence %	95% CI
Overweight/obesity	133	13.18	11.12-15.43
Corneal disorder	88	8.72	7.05-10.63
Otitis externa	76	7.53	5.98-9.34
Unspecified ear disorder	75	7.43	5.89-9.23
Anal sac impaction	66	6.54	5.09-8.25
Periodontal disease	62	6.14	4.74-7.81
Nails overlong	57	5.65	4.31-7.26
Brachycephalic obstructive airway syndrome (BOAS)	52	5.15	3.87-6.70
Vomiting	50	4.96	3.70-6.48
Diarrhoea	38	3.77	2.69-5.13
Upper respiratory tract noise increased	36	3.57	2.51-4.91
Intertrigo	32	3.17	2.18-4.45
Retained deciduous tooth	31	3.07	2.10-4.33
Umbilical hernia	28	2.78	1.85-3.99
Respiratory noise increased	28	2.78	1.85-3.99
Lameness	24	2.38	1.53-3.52
Ocular discharge	22	2.18	1.37-3.28
Pruritus	22	2.18	1.37-3.28
Pyotraumatic dermatitis	21	2.08	1.29-3.16
Alopecia	20	1.98	1.21-3.04
Conjunctivitis	19	1.88	1.14-2.93
Keratoconjunctivitis sicca	19	1.88	1.14-2.93
Coughing	18	1.78	1.06-2.80
Pyoderma	17	1.68	0.98-2.68

Table 1: Prevalence of the 25 most common disorders as diagnosed in Pugs attending primary-care veterinary practices participating in the VetCompass Programme in England from January 1, 2013 to December 31, 2013 (n = 1,009).

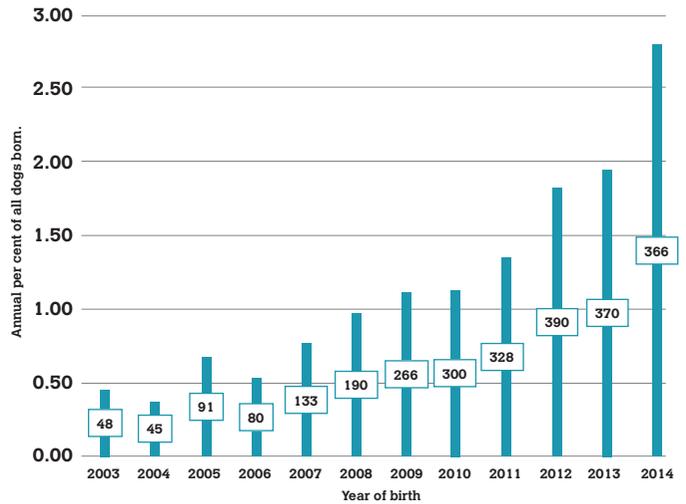


Figure 2: Annual proportional birth rates (2003-2014) for Pugs among all dogs (n = 263,456) attending VetCompass primary-care veterinary clinics in England. The annual birth count of Pugs is shown in each bar.

curves showed rapid growth during the first year of life (see Figure 3). The median bodyweight across all ages for males (8.9 kg, IQR: 7.1-10.3, range: 0.2-19.8) was higher than for females was (7.3 kg, IQR: 5.0-8.5, range: 0.3-17.9) (p < 0.001).

COMMON DISORDERS

Data were extracted on all disorders recorded during 2013 on 1,009 Pugs under veterinary care during 2013 (ie. one-year period prevalence). These disorders are shown both as diagnosed and also where similar diagnosed disorders were grouped into general categories. Elective (eg. neutering) or prophylactic (eg. vaccination) clinical events were not included. Dental disorders were included only where some clinical management intervention was recommended. These Pugs were registered across 102 veterinary practices, with a median count of seven Pugs per practice (interquartile range [IQR] 4-13, range 1-52). There were 688 (68.19%) Pugs with at least one disorder recorded during 2013 while the remainder (31.81%) had no disorder recorded. The median count of disorders per dog during 2013 was one disorder (IQR 0-3, range 0-9).

Overall, during 2013, 1,641 unique, disorder events were recorded that encompassed 213 distinct as diagnosed disorder types. The most prevalent as diagnosed disorders were: overweight/obesity (prevalence: 13.18%, 95% CI: 11.12-15.43), corneal disorder (8.72%, 95% CI: 7.05-10.63), otitis externa (7.53%, 95% CI: 5.98-9.34), unspecified ear disorder (7.43%, 95% CI: 5.89-9.23), anal sac impaction (6.54%, 95% CI: 5.09-8.25) and periodontal disease (6.14%, 95% CI: 4.74-7.81 [see Table 1]).

There were 48 distinct grouped disorder types recorded. The most prevalent grouped disorders were ophthalmological (16.25%, 95% CI: 14.03-18.68), dermatological (15.7, 15.60%, 95% CI: 13.38-17.95), aural (15.2, 15.06%, 95% CI: 12.91-17.42), overweight/obesity (13.3, 13.18%, 95% CI: 11.15-15.43) and enteropathy (11.3, 11.20%, 95% CI: 9.32-13.31, [see Table 1]).

DISCUSSION

This study of over 1,000 animals is the largest analysis of

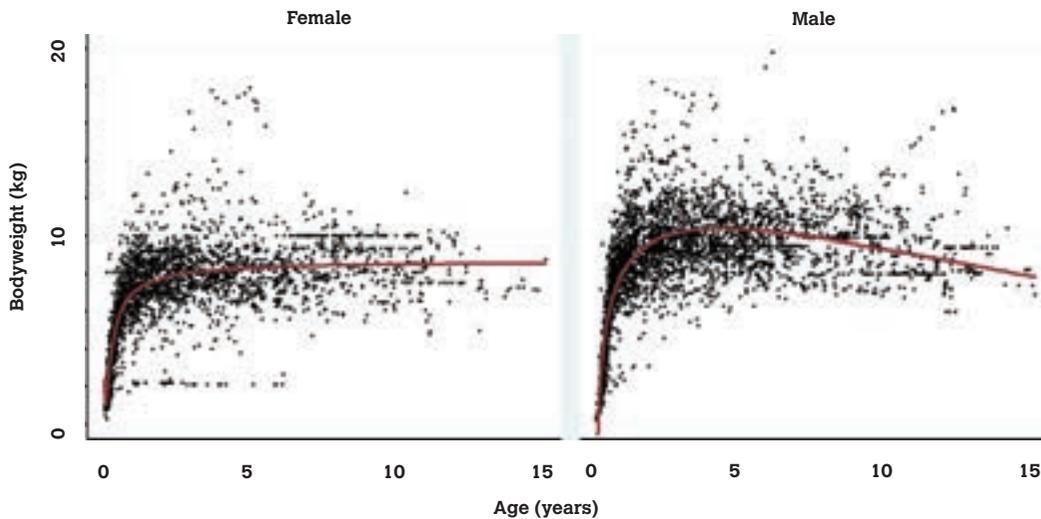


Figure 3: Bodyweight growth curves overlaid with a fractional-polynomial prediction plot for female and male Pugs attending primary-care veterinary clinics in England participating in the VetCompass Programme (females n = 772, males n = 992).

breed health in Pugs based on primary-care veterinary records to date and shows the power of VetCompass Big Data to answer a wide breadth of veterinary health questions. The UK is now well served by VetCompass data collection and projects are underway in Australia, Sweden, Denmark, Spain, Germany and the US to establish similar systems that require no changes to day-to-day clinical recording activities of primary-care practitioners.¹⁴ It is to be hoped that the desire exists for a similar system to be established in Ireland in the future also.

The steep three-fold rise in Pug ownership in recent years has been ascribed to anthropomorphic preferences of owners who perceive physical characteristics such as flat faces and large eyes^{7,15} and behaviours such as tractability, attention seeking, begging for food and waiting patiently¹⁶⁻¹⁸ as endearing and child-like or baby-like (paedomorphic). Social effects, such as celebrity endorsement and product advertising that heavily feature Pugs, may also strongly influence breed selection decisions by prospective puppy buyers.¹⁹⁻²³ However, increasing popularity is not necessarily a benign phenomenon for overall dog welfare. Extreme conformational features of the Pug such as large dark round eyes and flat faces that are appealing to humans have been associated with welfare concerns for the dogs.^{7,15,24} There are also fears that increased demand for Pugs may contribute to suboptimal breeding and welfare standards as breeders and suppliers rapidly attempt to fulfil the heightened consumer demand.²⁵ Large numbers of Pug puppies are reported to be imported into the UK, both legally and illegally, with consequent health and behavior risks to these puppies themselves as well as concerns about the introduction of non-endemic diseases such as rabies into the UK.²⁶⁻²⁸ Consequently, surveillance of the health of the general population of Pugs in the UK is of increasing importance to support both dog welfare and UK national disease status activities.

It is worth noting however, that 32% of Pugs under veterinary care did not have any disorders recorded during the one year period of surveillance (2013) of this study and were presented either for routine or prophylactic veterinary care

Grouped disorder	Count	Prevalence	95% CI
Ophthalmological	164	16.25	14.03-18.68
Dermatological	157	15.60	13.38-17.95
Aural	152	15.06	12.91-17.42
Overweight/obesity	133	13.18	11.15-15.43
Enteropathy	113	11.20	9.32-13.31
Upper respiratory tract	105	10.41	8.59-12.46
Congenital	91	9.02	7.32-10.96
Claw/nail	73	7.23	5.71-9.01
Anal sac	70	6.94	5.45-8.68
Dental	66	6.54	5.09-8.25
Musculoskeletal	52	5.15	3.87-6.70
Lower respiratory tract	43	4.26	3.10-5.70
Mass lesion	35	3.47	2.43-4.79
Parasite infestation	35	3.47	2.43-4.79
Female reproductive system	30	2.97	2.01-4.22
Hernia	30	2.97	2.01-4.22
Brain	29	2.87	1.93-4.10
Traumatic injury	27	2.68	1.77-3.87
Urinary system	21	2.08	1.29-3.16
Lethargy	17	1.68	0.98-2.68
Neoplasia	15	1.49	0.83-2.44
Spinal cord	14	1.39	0.76-2.32
Undesirable behaviours	13	1.29	0.69-2.19
Collapse/syncopal episodes	8	0.79	0.40-1.56
Foreign body	8	0.79	0.40-1.56

Table 2: Prevalence of the 25 most common grouped disorders recorded in Pugs attending primary-care veterinary practices in England participating in the VetCompass Programme from January 1, 2013 to December 31, 2013 (n = 1,009).

only or did not attend the veterinary clinic at all. These results suggest that, despite well-documented health concerns in Pugs, not all individuals in this breed will be diagnosed with illness over extended periods of observation and that gaining a full understanding of health issues in Pugs is a complex undertaking that also requires data on disease duration and severity.^{4,29}

Overweight/obesity was the most common single disorder recorded in the current study, with 13% of Pugs affected. By comparison, just 6% of dogs were recorded with overweight/obesity in an earlier VetCompass study across all dog breeds using a similar methodology.¹¹ Obesity has previously been recognised as a serious concern in Pugs by the Kennel Club who include it as a point of concern for special attention by show judges under its Breedwatch scheme.⁸ Obesity is a clinically relevant disorder in dogs because of associations with disorders including diabetes mellitus, cardiovascular, skin and musculoskeletal disease, exercise and heat intolerance, metabolic syndrome and increased surgical and anaesthetic risk.³⁰⁻³³ Overweight/obesity should be considered a health priority in Pugs because of the high prevalence, associated health problems and especially because of the reversible nature of the disorder.³⁴

Corneal disorders were the second most common specific disorder recorded, with almost 9% of Pugs affected during the study year. In contrast, corneal disorders did not even rank among the top twenty disorders recorded across all dog breeds in England.¹¹ Corneal disorders cover a spectrum of presentations including pigmentation, opacity, vascularisation, scarring, erosion, ulceration and perforation.³⁵ A high prevalence of primary periocular and ocular problems

previously documented in Pugs, including macroblepharon, entropion, distichiasis, ectopic cilia and keratoconjunctivitis sicca, and selection towards exaggerated brachycephalic facial morphologies^{7,24,36,37} may predispose to secondary corneal disease.³⁸⁻⁴²

The UK Kennel Club has taken efforts to redress these associations by listing Pugs as a category 3 breed in their 'Breed Watch' system and has recently revised the Pug breed standard to discourage severe exaggeration.^{5,8}

Given that the canine cornea is densely innervated by nociceptive afferent axons and that corneal damage is believed to cause substantial pain,⁴³ the results from the current study showing that ophthalmological disorders were the most common grouped disorder in Pugs, with over 16% of dogs affected, suggest that prioritisation of the extent and nature of brachycephaly for ongoing health surveillance and reform will be important to improve the health welfare of Pugs.

Brachycephalic obstructive airway syndrome (BOAS) defines variable clinical presentations resulting from underlying primary or secondary disorders that include stenotic nares, enlarged tonsils, elongated soft palate, everted lateral sacculles of the larynx, narrowed rima glottides, collapse of the larynx and tracheal hypoplasia.⁴⁴⁻⁴⁶

Dogs affected by BOAS often have severe dyspnoea and inspiratory stridor leading to exercise intolerance and potentially heat stress.⁴⁶

Unremitting or remitting breathlessness ('air hunger') can have severe welfare implications over prolonged proportions of the lives of affected dogs,^{45,47} with severely affected animals being fully engaged in active breathing efforts to

READER QUESTIONS AND ANSWERS

1. WHERE DOES THE PUG BREED NAME DERIVE FROM?

- A The breed was named after the dog owned by Pug, one of the Bash Street Kids in the Beano.
- B The Pug name derives from the Latin word pugnus meaning fist, because the side profile of the Pug head resembled the shape of a closed fist.
- C The Pug name derives from the Latin word pugnus meaning fist, because the breed was originally used for fighting.
- D The breed originates from the Pug region in ancient China.
- E The name is a contraction of 'plain ugly'.

2. THE CLINICAL RECORDS OF HOW MANY ANIMALS ARE CURRENTLY WITHIN VETCOMPASS?

- A 600
- B 6,000
- C 60,000
- D 600,000
- E 6,000,000

3. WHAT PROPORTION OF ALL VETCOMPASS PUPPIES BORN IN 2013 WERE PUGS?

- A 0.8%
- B 1.8%
- C 2.8%
- D 3.8%
- E 4.8%

4. WHAT WAS THE MOST PREVALENT AS DIAGNOSED DISORDER IN PUGS?

- A otitis externa
- B corneal disorder
- C periodontal disease
- D overweight/obesity
- E anal sac impaction

5. WHAT WAS THE PREVALENCE OF CORNEAL DISORDER AS DIAGNOSED IN PUGS DURING 2013?

- A 0.7%
- B 2.7%
- C 4.7%
- D 6.7%
- E 8.7%

ANSWERS: 1: C; 2: E; 3: C; 4: D; 5: E

