Welfare aspects in breeding brachycephalic dogs

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Abstract: Aim of our stud was to discover how different traits of brachycephalic dogs are connected to the frequency and number of their symptoms, and what are the consequences of these in making breeding strategies. 42 pugs and 19 French bulldogs were investigated during regular vet checks. We've recorded all symptoms connected to brachycephalic syndrome discoverable and registered in their anamnesis, by the help of veterinarians. Next to recording the dogs' breed, sex, colour the following body measures were taken: length of the nose bridge, height at withers, and length of the topline. The ratio of all disease is much higher in our study than reported in a recent questionnaire study in Hungary, suggesting the need of objective control when trying to measure frequencies instead relying on dog owners. Non-recognized colour variants had shown late onset diseases significantly more frequently, enlightening how puppy mills work. However, eye defects appearing as a consequence of head conformation being more frequent in registered colours point on the effect of breeding determined by dog shows. Nose length being significantly longer in healthy dogs suggests, that this quantitative measure could be used in selection.

Keywords: brachycephalic dog, breeding, welfare

Introduction

Brachycephalic dog breeds became widespread in the last two decades. According to researches, their baby-like appearance – what Lorenz (1971) described as "baby scheme" – and the fact, that they seek more eye contact with owners, better in understanding human pointing gestures (Gácsi et al, 2009) triggered their popularity. However, owners of their dogs base their decision in choosing a breed more mostly on their appearance (Packer et al, 2017), and a bigger part of them tend to accept the health state of their dogs as a breed trademark, or even denies that their own dog could have any problems (Packer et al, 2019).

Brachycephalic obstructive airway syndrome (BOAS) is the name those dogs are frequently affected with. Skull conformation leads to the compression of nasal passages, and additional mucosal hyperplasia and secondary collapse of the upper airway contribute to multilevel obstruction (Dupre and Heidenreich, 2016). The symptoms are not limited to the respiratory tract, but these dogs can suffer from a range of digestive disorders, apnoea, exercise and heat intolerance, various dermatological and ocular conditions (Roedler et al, 2013, Pratschke, 2014).

Phenotype variance of head shape in domestic dogs exceeds the variance measurable in the whole Canidae (Drake and Klingenberg, 2010). Brachycephalic shape is a result of selective breeding, in case of some breeds for enhancing the strength of bite, in companion dogs for achieving the baby-like appearance (Packer and Tivers, 2015). Brachycephalic shape in regulated by a major gene BMP3 on CFA32), showing incomplete dominance. However, skull shape as such is a polygenic trait, some other genes (e.g. RUNX2 on CFA12 or SMOC2 on CFA1) in its background are already mapped (Ekenstedtet al, 2021). So both when dealing with body measures like that, both in handling a polygenic syndrome this head shape causes we have to use the methods of quantitative genetics.

BOAS is screened in many countries by an exercise test, with a grading 0 to 4. That proved to be a useful tool not only in screening, but also in making breeding decisions. In Finnish population estimated heritability values for that scores were $h^2 = 0.39 – 0.58$ is pugs and French bulldogs (Lilja-Maula et al, 2024). Unfortunately, that is not used in Hungary yet. However, that test is limited, as not being able to detect ocular and gastrointestinal diseases, which frequently accompany the brachycephalic symptom.

Materials and Methods

Data of 61 brachycephalic dogs (n = 42 pugs and n = 19 French bulldogs) was collected at four veterinary clinics in Budapest, where dogs came for regular checks, during 2023–2024. We've recorded the dogs' breed, sex, neuter status, colour and whether they're pedigree registered or not. Four body measures were also recorded: body weight (kg) by a scale, others with a measuring tape. For measuring the length of nosebridge (mm) a piece of yarn was also used for enhancing accuracy. Nose length was measured for the top of the nose until the stop. Height at withers (cm) at the highest part of the shoulder blade, starting from the ground, while length of the topline between the withers and the tailset. The body condition score of the dogs was determined according a general 1(thin) – 9 (obese) scale, compared to illustrations. Medical problems connected to brachycephalic syndrome were determined by the help of veterinarians, and also collected the records from the available anamneses of dogs. For data recording we've used Excel, and for statistical analysis SPSS.29.

Results and discussion

We've analysed the recorded diseases separately – those, which were rare in the population together - and grouped by the organs affected as well.

Dyspnoea (breathing difficulty) proved to be the most frequent in the population (44.3% of dogs studied were affected), next entropion and pigmentary keratitis, both with 21.3% frequency. Narrow nostrils, cornea injuries /ulcer, acidic vomit affected approx. 10% of the dogs, cherry eye and gastrointestinal problems more than 3%. Other diseases recorded had been epilepsy, heat stress in the past, glaucoma, dry eye, elongated soft palate. So similar to what Pratschke (2014) found, not only the respiratory system of the brachycephalic dogs was affected, but they also had ocular and gastrointestinal diseases.

A recent Hungarian questionnaire based publication (Tóth et al, 2024) measured the frequency of brachycephalic syndrome 11.3–11.4%, and of eye diseases 26.5–30%. These ratios are much higher in our study, 44.3% of dogs showing respiratory symptoms, while 49.3 ocular ones.

Affected dogs had shown 1 (27.9%) to 5 (4,9%) symptoms of the syndrome. However, one, two – with same ration – and three signs together were the more frequent, contradicting the results of Fasanella et al. (2010), who found that dogs usually show 3–4 symptoms together.

There's no significant difference in the population studied between the two breeds in the frequencies of given symptoms neither in their quantity (Mann-Whitney tests). That contradicts to the results of Roedler et al (2013), who found more gastrointestinal diseases in French bulldogs, and also the ones published by Lilja-Maula et al. (2024), according to which pugs are more affected with brachycephalic syndrome than French bulldogs.

Also didn't find a difference in the disease frequency between dogs (n = 33) and bitches (n = 28), neither in intact (n = 14) and neutered (n = 47) animals. Previous publications on different populations (Fasanella et al, 2010, Roedler et al, 2013) of these breeds suggested dogs being more severely affected.

Age of the dogs (mean value 5,95 ± 2,97) affected the prevalence of acidic vomiting (ANOVA, $p \leq 0.05$). According to literature, the disease is getting more sever with age.

The fact that the dog is Kennel Club registered – their ratio was only 13,1% in our sample – didn't make a difference in disease frequency, similar to what Tóth et al. (2024) did found. As no obligatory health check is needed now in Hungary for pedigree registration that is a result expected.

We've compared by Kruskal-Wallis tests all the coat colour variants in our sample, and also looked for difference between officially recognized colours in the breed standard and non-recognized ones (Mann-Whitney tests). In all-round comparison blue French bulldogs proved to be more frequently affected with acidic vomiting, and gastrointestinal symptoms ($p \leq 0.05$). Dogs with non-recognized colour – so quite likely born in a puppy mill – more frequently showed other, late onset accompanying diseases of brachycephalic syndrome, such as epilepsy, heat stroke, ear inflammation ($p \leq 0.05$). Those diseases are not recognisable when puppies are sold. At the same time, dogs with a recognized coat colour – so possible descendants of show dogs in some generation distance– were affected with ocular problems more often ($p \leq 0.05$). Those eye deformations are the most directly connected to head conformation, which had been under sever selection pressure for a long time in the past by approach of making breed specific features more and more pronounced.

Height at withers is according to the standard values in French bulldogs in our sample (34 ± 3,04 cm), in pugs the standard is not providing a value for it, but they're smaller, and

that is true to the studied population (28 ± 5,12 cm). The breed standard calls for a bit longer dog than how tall it is in French bulldogs and for a quadratic one in pugs. By determining the heath at withers-topline length ratio our sample mostly fulfil it, although standard deviation is quite high. When comparing the body weight values to the ones in the breed standards it is visible, that the studied population is overweight in average (14.56 ± 2.83 kg French bulldogs, 9.65 ± 2.36 kg pugs). The body condition score being 6.1 ± 1.23 also suggest that. The ratio of overweight and obese dogs in the population studied is 34.3%, so much more than 6.38%, as reported for those breeds according a database in Great Britain (O'Neil et al, 2020).

Body weight of dogs showing gastrointestinal symptoms is significantly higher than of in that case healthy ones (t test, $p \leq 0.05$). Body condition score significantly affects (ANOVA, $p \leq 0.05$) the number of symptoms visible, all respiratory diseases, dyspnoea, all gastrointestinal diseases, and elongated soft palate. The mean body condition score of dogs diagnosed with gastrointestinal inflammation and elongated soft palate is higher than of dogs free from these (t test). So overweight and obesity is a risk factor in brachycephalic syndrome.

Nose length affects the appearance of ulcer in the cornea (ANOVA, $p \leq 0.05$). Nose of dogs diagnosed with entropion is significantly shorter (13.31 ± 5.33 mm), than those free from it (17.94 ± 6.72 mm). Same applies to dispnoe, 14,44 ± 6,88 mm nose lenght in ill, and 18.94±6.08 mm in healthy dogs (t tests, $p \leq 0.05$). Nose - toplie length index shows the same significant difference for the symptoms above, and also for narrow nostrils and cherry eye. Nose length – height at withers index also highlights the same significant differences by t tests. So nose length measured can be a quantitative trait obtained for screening brachycephalic syndrome, and together with other body measures could have even higher predictive value. Packer et al. (2015) also suggests selecting dogs with longer noses for breeding, utilising phenotype variability.

Topline is significantly (t tests, $p \leq 0.05$) longer in dogs with entropion, elongated soft palate and gastrointestinal problems. However, these results most likely to be an outcome of dogs with non-standard body ratios originating from puppy mills and backyard breeding, rather than an anatomical correlation. On other hand, dogs having narrow nostrils being shorter – which is also our result – could be the consequence of show breeding in the previous paradigm.

Conclusions

The much higher rate of dog affected with brachycephalic syndrome in our study than published by Tóth et al. (2024) based on a questionnaire study, both about the current Hungarian population suggest that the owners attitude for denying the existence of the problem in their own dogs, reported by Packer et al. (2012) can exist. Therefore when making up a selection programme it is crucial to define the phenotypes connected to the symptoms objectively, by veterinary assistance.

As recently there's no official control exist for brachycephalic syndrome in the breeding requirements, not surprisingly being pedigree registered doesn't mean healthier dogs. However, the population is separated: dogs of non-recognized colour variants, so supposedly originating from puppy mills show a range of late onset symptoms and diseases more frequently, while dogs connected closer to the pedigree breeding – when selection for toy

dogs is based on dog show results – are more often affected with symptoms connected to the extreme head conformation.

Overweight dogs are much too frequent in these breeds nowadays in Hungary, and that makes the symptom worse for the welfare of the animals. All professionals working with dogs have to be aware of educating dog owners about the importance of normal body condition. On other hand, introducing the exercise-based BOAS grading system would be beneficial, but until he overall condition of the dogs is like this, it's use in selection would be limited, as an environmental effect masks the genotype in great extent.

Nose length proved to be a good indicator of health status according brachycephalic syndrome, measured together with height at withers or length of the topline even more suitable for distinguishing between functionally healthy and problematic animals. Those measurements would be easy to take during compulsory conformation judgements for breeding licences. When available for a larger part of the population of those breeds this body measure and indexes could be used as quantitative traits for calculating heritability values, then determining breeding values, utilize in selection.

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