The Bulldog Clubs of New Zealand

Steven Thompson
Director Secretary
By Email

4 June 2019

Dear Steven

The New Zealand Bulldog Breed Standard

Summary

1. In August 2017 the President of DogsNZ said at a meeting with the Southern Bulldog Club Committee that the best way to progress things with the NZ Bulldog Breed Standard was to work with the clubs, not against them. The actions of DogsNZ and the Executive Council since then have shown none of that goodwill.

2. DogsNZ has shown it has little concern or consideration for the tenets of natural justice or fairness. It certainly does not respect the views of Specialist Breed Clubs.

3. The actions of DogsNZ through the Canine Health & Welfare Committee and the Executive Council have brought the organisation into disrepute. Both unilateral and without mandate their decisions have been based upon selective assessments of the evidence and have been predetermined. Predetermination which has been stated to third parties and to Bulldog Club members. The actions described raise significant concerns not only for our Bulldog Clubs but for Specialist Breed Clubs and for DogsNZ membership as a whole.

4. Therefore prior to our Bulldog Clubs writing to all All Breeds Clubs and Specialist Breed Clubs seeking support for a Special General Meeting to hear our concerns and recommendations both of a vote of no confidence in the current Executive Council and Canine Health & Welfare Committee and constitutional change to enshrine protections for Specialist Breed Clubs such as ourselves, we are writing to you.

Specific Comment

The Law

5. In making decisions affecting the actions of its members DogsNZ is not immune to its legal obligations as decision maker. These include accepted administrative law concepts of:
    a. Adherence to natural justice and specifically the obligation to decide on an unbiased and disinterested basis. And in anticipation of this that DogsNZ would not make statements to third parties predetermining their decision to change the NZ Bulldog Standard;
    b. Recognition that our Bulldog Clubs had and have a legitimate expectation both that:
        i. assurances would be kept, including the Presidents statement that DogsNZ would work with the Bulldog Clubs on the matter of the NZ Bulldog Breed Standard; and
        ii. that the Executive Council would not fetter its discretion to make a fair decision. Commitment to change having occurred when employees were allowed to make predeterminative statements and when only two options both seeking change were set.
    c. The implications of both natural justice and legitimate expectation including estoppel (stopping of actions in contravention of the law).

6. Finally, DogsNZ, its committees, employees and Executive Council must understand and be answerable to its own rules. This expressly includes compliance with its foundation objects: the purposes for which the organisation is established. Sub clause 2(d) states that an Object of DogsNZ is:

    the organisation of dog owners and other persons interested in the well-being of dogs for the purpose of advancing and protecting the interests of such persons generally; and for the purpose of ensuring the well-being of dogs in New Zealand

7. The organisation of people for the advancement of <u>their</u> interests does not create a mandate to act to their detriment.

The NZ Bulldog Standard

8. We now face a further survey or poll seeking to change the NZ Bulldog Standard. Proposed for the good of us all. This decision is not reflective of the submissions made by the Bulldog Clubs and members, the recommendations of the Breed Standards Committee that is tasked with reviewing standards and accepted by the DogsNZ Executive Council just 6 months ago. Submissions which set out clearly the bases for retention of the NZ Bulldog Standard.

9. In contrast the Bulldog Clubs have released a template submission which provides for all three possible options including no change of the NZ Bulldog Breed Standard. We are told however that if we don't accept our fate and the two options for change, that the majority of votes in favour (whomever has made them) will determine which change is made. The submissions, the Bulldog Clubs, their members, irrelevant. Accept and vote in the survey or accept the consequences.

10. Given this background we would like to ask each of the Executive Council to confirm their understanding of the bases for change. We ask:

a. ***Can you be confident that the assessment of the evidence you have been provided actually is accurate and that it is sufficient to make a decision?***

DogsNZ case and the scientific bases for changing the NZ Bulldog Breed Standard are set out in the Canine Health & Welfare Report (**CHW Report**) attached to DogsNZ letter dated 13 May 2019. The CHW Report refers to the Liu et al research (**2017 Liu Report**) as the evidential basis for the changes proposed.

Although only the 2017 Liu Report is referenced in DogsNZ correspondence to clubs and members. The letters still state there is "significant scientific evidence" which compels the changes DogsNZ say are for the betterment of the NZ Bulldog and specifically their breathing. When pushed by our Bulldog Clubs for the relevant New Zealand research, reference was made instead to international research. When asked for details of that research, other than the 2017 Liu Report we have been provided with no further evidence.

When reviewed it is clear that the 2017 Liu Report is inaccurately reported in the CHW Report. The CHW Report refers to a diagram suggesting a correlation between Skull Index and BOAS. Skull Index contemplates size and width. That correlation was not only there but the CHW Report goes on to state that Skull Index has a "significant and reliable" connection to BOAS.

This statement by the CHW Report writer contrasts directly with the researcher's in the 2017 Liu Report who say that the outcome of their study was that there was only a **weak** correlation to Bulldog skull size (**CFR**) and BOAS.

The 2017 Liu Report also states:

*"SI in bulldogs, were associated with BOAS but had **poor-moderate** inter-observer reproducibility. Nevertheless, they **may be** of use for directing the reformation of breed standards." (Emphasis added)*

Again, a clear contradiction between the CHW Report's stated significant and reliable association with BOAS and the 2017 Liu Report (upon which all of the publicly presented DogsNZ reasoning for change is based).

Rather the 2017 Liu Report states that emphasis for both breeders, breeding should be placed on reducing stenosis and obesity in Bulldogs. An earlier report by the same researchers relating to Whole of Body Barometrics further reinforces this point. Both pieces of research set out clearly the primary conformational predictors of BOAS which are stenosis of nostrils and obesity - neither of which are promoted by the NZ Bulldog Breed Standard.

Instead, the NZ Bulldog Breed Standard promotes nostrils which are large and wide and weight ranges which would not have bulldogs obese. In contrast the majority of the areas requiring change identified in the CHW Report are related to the size and shape of the Bulldog Head. Changes to conformation which DogsNZ own research says has weak or poor to moderate effect on BOAS.

Given the points above we have to ask:

a. If the CHW Report is in error with respect to the matters above, what else may be?
b. Why was the CHW Report presented with these errors?
c. Why was it accepted by the Canine Health & Welfare Committee and presented to Executive Council?
d. Why did Executive Council accept it?
e. Can the bases and recommendations of the CHW Report be relied upon given it contradicts the 2017 Liu Report?

Further '**may be**" would hardly seem like a directive for change. In the absence of the certainty and sound scientific evidence claimed by DogsNZ and the fact that the key predictors for BOAS are not supported by the NZ Breed Standard we would argue that there is little to no basis for change. Rather we would suggest that what is needed is education promoting health testing and of what a healthy bulldog bred to the NZ Breed Standard is and should be.

Finally, the other non-breathing related health issues raised in the CHW Report have not been supported with evidence nor their relevance to the wording of the NZ Bulldog Breed Standard. We can only comment therefore that those issues as with the BOAS are part of our Bulldog Health Scheme. We do not consider however that they are directly referred to or promoted in the wording of the NZ Bulldog Breed Standard and in the absence of evidence to the contrary ask how the Executive Council can either?

We **attach** as Appendix A extracts from both the 2017 Liu Report and the Whole of Body Barometrics Report for you to read alongside the statement made in the CHW Report.

b. ***Why the rush?*** We have been told that we must act or face the wrath of the New Zealand Government.

However, the NAWACs Opinion on Selective Breeding recommends where testing is not available that consideration be given to the content of breed standards which reflect a focus on health testing first and foremost.

There is adequate Health Testing available and undertaken in New Zealand. Both with the DogsNZs Accredited Breeder Scheme, the Litter Registration Limitations for those breeds that choose to use them and Specialist Breed Club run Health Schemes such as those provided by the Bulldog Clubs. Health testing which reflects the recommendations in the NAWAC opinion. Testing that NAWAC at the presentation in May 2019 acknowledged.

MPI Officials have confirmed that issues with brachycephalic breeds are not on their workplan. Nor after engagement with the Minister and her officials during the development of the Animal Welfare Framework are brachycephalic breeds referred to either.

We have to ask why is there the need to move now to change the NZ Bulldog Standard? Why not let the health work continue and build an understanding of the situation in New Zealand? Why not engage positively with the clubs and with officials on the work being done?

We **attach** as Appendix B our representatives notes for the NAWAC meeting 23 May 2019 and a copy of the Animal Welfare Framework.

c. ***Where is the data to back your claims?*** Again, this data is suggested to be the basis for the Executives decision to change the NZ Bulldog Breed Standard. Where is it?

Both the 2017 Liu Report upon which much of the weight for change is based and the earlier Whole of Body Barometrics Report state that the research outcomes identified in their reports have limits. Those limits are based largely on the need for more subjects and data. There are no statistics available or indeed that exist, for affected bulldogs in New Zealand. That data and insight will build with the health testing currently underway. Again, what is the rush? If the health testing is happening, we are in compliance with NAWAC and there is time to build a clear snapshot of the health of registered Bulldogs and in addition compare that to non-registered dogs.

d. ***Since rescinding your decision how can you say the process has been legitimate?***

A legitimate process has already been undertaken, submissions received and the recommendation from the Breeds Standard Committee was to retain status quo. This recommendation was accepted by the Executive Council, so what has caused the change? The evidence and information referred to now is no different to that submitted on in 2018 and upon which the committee responsible for Breed Standards recommended and Executive Councils decision to retain the NZ Bulldog Breed Standard was made.

It cannot simply be because DogsNZ employees (and Canine Health & Welfare Committee members) have made pronouncements and promises of change to NAWAC, the NZVA and SPCA? Given there was no need, has DogsNZ simply jumped the gun and are now cleaning up after themselves?

Whether this is the case, the existence of evidence and witnesses to at least two occasions of DogsNZ employees stating that the decision to change the NZ Bulldog Breed Standard has been made, is of itself evidence of bias and fettering of the Executive Council's discretion making powers through pre determination. Given all the points above how can the recommendations of the Canine Health & Welfare Committee and the CHW Report be relied upon? How can the Executive Council make a decision now that is not tainted by this background and process?

We **attach** as Appendix C a short chronology of the process taken to date to change the NZ Bulldog Breed Standard.

11. Further we note the reference in the CHW Report:

a. To the Dutch regulations as a basis for action now, the alternative being regulation here in New Zealand. This matter has received significant attention thanks to animal welfare groups pushing it out across social media. Speaking to Dutch breeders and law makers we understand that this is not the first guideline or criteria released by the Dutch government but both the Dutch Kennel Club and FCI are confident it will

not lead to breed bans. Further the Dutch foundation legislation has been in place for some time and no other country internationally has followed suit.

b. To the comments of a vet being the basis for the standard being the basis for presumed improvement of Bulldog health. The UK Bulldog Clubs have not supported that proposition. Rather they consider the significantly longer period of health testing through the Bulldog Clubs and Council run health schemes and education having the greatest effect on bulldog health.

c. To the comment about regulatory responsibility; as stated above our breeds are not on their workplan for regulation nor do they form part of the Animal Welfare Framework. Nor was there the interest at the NAWAC table to change this given the work being done with health testing. Rather breeder registries were the focus with NAWAC and it would seem to us the example closer to home of an "All breeder Sale Registry" in Victoria Australia should be the greater local concern for DogsNZ then a non-legally binding criteria in the Netherlands.

d. To the presumption that the changes proposed to the NZ Bulldog Breed Standard would place us in lock step with the world, this ignores two key points:

   i. The Breed Standards Committee is the responsible body for breed standards and understands the background and world view of standards. Surely weight should be given to the recommendations to retain the NZ Bulldog Standard and not the Canine Health & Welfare Committee utilising flawed information?

   ii. Our closest neighbour (from whom most of our judging appointments are drawn) has not changed their bulldog standard. The Australian Bulldog Clubs opposed the changes DogsNZ is promoting and the Australian Bulldog Breed Standard remains the same.

12. Ultimately in the absence of substantive scientific evidence, data or necessity to move so quickly we do not understand why DogsNZ have chosen such a destructive and antagonistic approach with our Bulldog Clubs. The fact that the Executive Council have done so on the basis of flawed advice from the Canine Health & Welfare Committee via the CHW Report and <u>against</u> the recommendation of the Breed Standards Committee which is tasked with this process, should be a significant concern for any Specialist Breed Club or breeder whom in the future does not fit with the DogsNZ philosophy, in contrast to its object of "advancing and protecting" their members interests.

The Precedent

13. Whether or not the NZ Bulldog Breed Standard can be legitimately changed, the actions of DogsNZ have raised considerable concern for our Bulldog Clubs, members and the wider DogsNZ membership. This is obvious given the over 1900 signatures on the Bulldog Clubs petition including a number of All Breeds Committee members and judges.

14. DogsNZ has too much power if the Executive Council considers it has the right to make decisions on the basis of the greater good, but to the detriment of breeds and breeders. Decisions which are wrapped in cloaks of sound and compelling evidence and research, but which when undone have little to none, are rebuttable and flawed.

15. Further for Specialist Breed Clubs, DogsNZs approach does not engender confidence that their members interests will be protected. DogsNZ has used this process to attempt to undermine

and attack the Bulldog Clubs. Statements made both to third parties and on social media suggesting a long-standing bias against the Bulldog Clubs who are simply complying with the direction given them at the 2017 ACOD. At which rather than accept them coming under the banner of DogsNZ, the Bulldog Clubs were told they should undertake their own work and develop their own structures – the taskforce, our health schemes all of it was in the terms of reference included in the ACOD handbook.

16. The Executive Council have shown in this process that unless a club meets their ever-changing expectations (we do not want you in 2017 but we do want you to do what we want in 2018 and 2019) then they will forever be at risk of being overruled. From an administrative law perspective alone, this is inappropriate. A member has the right to certainty of process, there has been no certainty nor uniformity of process in this instance. Nor is DogsNZ acting in the interests of its members in doing so.

17. In taking this approach DogsNZ is undermining the unity which will be essential in coming years if the issue of welfare is to be dealt with, with a common voice. That was the issue for NAWAC at their May 2019 meeting. It is the issue that raises considerable public and media scrutiny when animal welfare groups bring it to their attention. DogsNZs core function and object is to be a registry. But the value of this core role will mean little if considered too small or marginalised by overseas registries which are currently being used and advertised by breeders here.

18. DogsNZ needs to support and protect its members. To do so they actually need to listen to their members.

Recommendations

19. It is the Bulldog Clubs view that a number of things should happen:

    a. The survey of members seeking change of the NZ Bulldog Standard as currently released should be withdrawn.
    b. DogsNZ should engage with the Bulldog Clubs with a view to agreeing a timeframe for the embedding of their health schemes and development of NZ based data which could form the basis of further education and possible amendment of the NZ Bulldog Standard at a later date if it is shown that there is a correlation between the data and the standard.
    c. DogsNZ should engage with the Bulldog Clubs to develop an informed and unbiased statement for the approach recommended at point 2 above which can be presented to third parties when needed.
    d. DogsNZ should change its approach to regulatory and stakeholder engagement to ensure that statements made are not predetermined and reflect a fair and unbiased view of its membership.

20. We await a response from each of the Executive Council members. We will be providing copies of this letter and its attachments to each All Breeds Club and Specialist Breed Club. In the absence of resolution of the issues we have raised, we will be asking that 10 All Breeds Clubs agree to call a Special General Meeting under the DogsNZ Rules for the purpose of tabling:

a. a vote of no confidence in the current Executive Council;
b. a vote of no confidence in the current Canine Health & Welfare Committee;
c. resolution to rescind any decision to amend the NZ Bulldog Breed Standard; and
d. a resolution to amend the DogsNZ Rules and supporting Regulations to provide protection for Specialist Breed Clubs and their members.

21. The amendments to the rules and regulations proposed must include acknowledgement of the Specialist Breed Clubs as custodians of their specific breeds and as in other countries acceptance that they and their members should have final say on any decisions affecting their breeds specifically. This would include the amendment of breed standards, establishment of any mandatory health testing of those breeds and any subsequent amendments.

22. Finally, if a Special General Meeting is not required, we consider the amendments to protect Specialist Breed Clubs should still be dealt with agreement now that regulations will be put in place by the Executive Council and any rules required to be put forward in the 2020 ACOD for consideration.

23. We do not take this step lightly. However, we feel we have little option given the actions of the Executive Council and its employees. We await your response within 5 working days.

Yours sincerely

Kathy Brown – President Southern Bulldog Club

Frank Muncey – President Wellington Bulldog Club

Sue Chaytor – Secretary Central Bulldog Club

Amanda Rutherford – President Auckland Bulldog Club

Sue Tahere – President The French Bulldog Society

Appendix A: Health Report Extracts

PLOS ONE

Conformational risk factors of brachycephalic obstructive airway syndrome (BOAS) in pugs, French bulldogs, and bulldogs

Nai-Chieh Liu, Eileen L. Troconis, Lajos Kalmar, David J. Price, Hattie E. Wright, Vicki J. Adams, David R. Sargan , Jane F. Ladlow

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Abstract

Extremely brachycephalic, or short-muzzled, dog breeds such as pugs, French bulldogs, and bulldogs are prone to the conformation-related respiratory disorder—brachycephalic obstructive airway syndrome (BOAS). Affected dogs present with a wide range of clinical signs from snoring and exercise intolerance, to life-threatening events such as syncope. In this study, conformational risk factors for BOAS that could potentially aid in breeding away from BOAS were sought. Six hundred and four pugs, French bulldogs, and bulldogs were included in the study. Soft tape measurements of the head and body were used and the inter-observer reproducibility was evaluated. Breed-specific models were developed to assess the associations between the conformational factors and BOAS status based on functional grading. The models were further validated by means of a BOAS index, which is an objective measurement of respiratory function using whole-body barometric plethysmography. The final models have good predictive power for discriminating BOAS (-) and BOAS (+) phenotypes indicated by the area under the curve values of >80% on the receiver operating curves. When other factors were controlled, stenotic nostrils were associated with BOAS in all three breeds; pugs and bulldogs with higher body condition scores (BCS) had a higher risk of developing BOAS. Among the standardized conformational measurements (i.e. craniofacial ratio (CFR), eye width ratio (EWR), skull index (SI), neck girth ratio (NGR), and neck length ratio (NLR)), for pugs EWR and SI, for French bulldogs NGR and NLR, and for bulldogs SI and NGR showed significant associations with BOAS status. However, the NGR in bulldogs was the only significant predictor that also had satisfactory inter-observer reproducibility. A NGR higher than 0.71 in male bulldogs was predictive of BOAS with approximately 70% sensitivity and specificity. In conclusion, stenotic nostrils, BCS, and NGR were found to be valid, easily applicable predictors for BOAS (+).

Citation: Liu N-C, Troconis EL, Kalmar L, Price DJ, Wright HE, Adams VJ, et al. (2017) Conformational risk factors of brachycephalic obstructive airway syndrome (BOAS) in pugs, French bulldogs, and bulldogs. PLoS ONE 12(8): e0181928. https://doi.org/10.1371/journal.pone.0181928

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Data Availability: All relevant data are within the paper and its Supporting Information files.

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Competing interests: VJA runs her own commercial consultancy company, Vet Epi. There are no patents, products in development, or marketed products to declare. This does not alter our adherence to PLOS ONE policies on sharing data and materials.

Abbreviations: AIC, Akaike's Information Criterion; AUC, area under the curve; BCS, body condition score; BL, body length; BOAS, brachycephalic obstructive airway syndrome; BW, body weight; CFR, craniofacial ratio; CG, chest girth; CI, confidence interval; CL, cranial length; EMMS, electromedical measurement systems; ETT, exercise tolerance test; EW, eye width; EWR, eye width ratio; ICC, intra-class correlation coefficient; MV, minute volume; NG, neck girth; NGR, neck girth ratio; NL, neck length; NLR, neck length ratio; OR, odds ratio; PEF, peak expiratory flow rate; PIF, peak inspiratory flow rate; QDA, quadratic discriminant analysis; ROC, receiver operating characteristic; RR, respiratory rate; SD, standard deviation; SI, skull index; SL, skull length; SnL, snout length; SW, skull width; TBFVL, tidal breathing flow volume loops; Te, expiratory time; Ti, inspiratory time; TV, tidal volume; WBBP, whole-body barometric plethysmography

Introduction

Brachycephalic obstructive airway syndrome (BOAS) is a conformation-related respiratory disorder of dog breeds with shortened skulls and muzzles, such as the pug, the French bulldog, the bulldog, and others [1]. Breeding selection for extreme brachycephalia has resulted in deformation of the upper airway tract leading to obstruction, as the soft tissues have not reduced proportionately with the length of the skull [2]. Affected dogs show noisy and laboured breathing with exercise and heat intolerance, often accompanied by sleep disturbed breathing, gastrointestinal disorders such as regurgitation and vomiting, and in the worst cases,

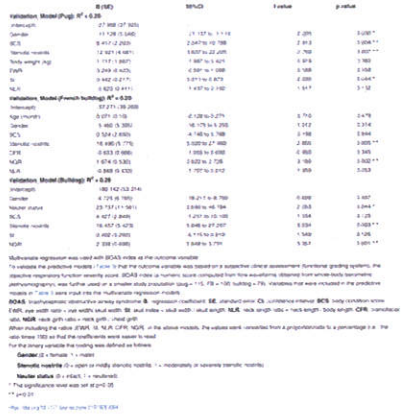

Table 4. Validation of the predictive models using BOAS index.
https://doi.org/10.1371/journal.pone.0181928.t004

French bulldogs

(1) Inter-observer reproducibility of soft tape measurements.

The inter-observer variations in soft tape measurements are shown in S1 and S2 Tables (raw data can be found in S1 data). Overall, most of the measurements and their ratios had poor to moderate agreement between the two observers. NG (ICC = 0.89, 95%CI: 0.74 to 0.95) and CG (ICC = 0.91, 95%CI: 0.78 to 0.96) measurements had good to excellent inter-observer agreement, but their ratio, NGR, had poor inter-observer agreement (ICC = 0.41, 95%CI: 0 to 0.71), which is likely contributed by the combinations of variances from NG and CG (Fig 3).

(2) Soft tape measurement of conformation in relation to BOAS.

The summary of each soft tape measurement with BOAS functional grade can be seen in S3 Table. Overall, the BOAS (+) dogs had significantly shorter SnL ($p = 0.035$), wider SW ($p<0.001$), wider EW ($p<0.001$), larger NG ($p<0.0001$), and longer BL ($p = 0.047$) than BOAS (-) dogs. In terms of ratios, the BOAS (+) French bulldog had significantly lower CFR ($p = 0.012$) and NLR ($p = 0.034$), and higher values of SI ($p = 0.042$) and NGR ($p<0.0001$). However, the distribution of ratios was similar to the pugs in that there are substantial overlaps in ratios among different functional grades (S1 Fig). Nonetheless, it is worth noting that the four French bulldogs that had CFR > 0.3 were all Grade 0.

(3) Full model of conformation, nostril stenosis and BCS predicting BOAS.

The results of the multivariate logistic regression model are shown in Table 3 (Raw data can be found in S2 Data). The final model for French bulldogs contained seven variables that accounted for 37% of the total variation in predicting BOAS (+). Male French bulldogs had 2.13 (95%CI: 1.1 to 4.2) times greater odds of being BOAS (+), than females. French bulldogs that had moderately/severely stenotic nostrils had 5.65 (95%CI: 2.65 to 12.68) times greater odds of being BOAS (+) than those with open/mildly stenotic nostrils. Fig 4 shows a clear trend that the higher the functional grade the higher the proportion of dogs with moderate/severe nostril stenosis.

Fig 5 gives an indication of the effect of each conformational ratio on the probability of BOAS; depicting the univariate logistic curve fit to each ratio individually. NGR was significantly associated with BOAS in French bulldogs, with odds ratios of 1.12 (95%CI: 1.05 to 1.21) for an increase of 0.01 in NGR, respectively. NLR was significantly associated with BOAS, with an odds ratio of 1.07 (95% CI: 1.01 to 1.14) for a decrease of 0.01 in NLR. In addition, there was a tendency for a reduction in CFR to be associated with BOAS, although this was not significant ($p = 0.153$): the estimated odds ratio was 1.07 (95% CI: 0.98 to 1.17) for a decrease of 0.01 in CFR. BCS was retained in the best-fit model, however, it was not significant ($p = 0.148$). There was no clear relationship between BCS and BOAS functional grade (Fig 4). Note that, in French bulldogs, 15% of Grade III dogs had BCS of 3, considered as underweight, which accounts for the majority of underweight French bulldogs among the population.

Fig 6 shows the predictive performance of the final model. The classification was based on a cut-off value of 0.5 as before (Fig 6A). The model had AUC of ROC at 80% (95%CI: 74% to 86%), considered as good accuracy in classifying BOAS (+) and BOAS (-) dogs.

(4) Validation of the model using BOAS index.

The BOAS (+) prevalence (functional grade II/III) was not significantly different between the total study French bulldogs (i.e. all study French bulldogs) and the French bulldogs in the validation population (i.e. the ones that had BOAS index available) ($\chi^2 = 0.022$, $p = 0.883$). The results of the multivariate linear regression model can be found in Table 4 (Raw data can be found in S3 Data). The adjusted R-squared value of the multivariate linear regression model was 0.2, indicating the proportion of variability in BOAS index that can be explained by the models. The degree of stenotic nostrils was a significant predictor ($p = 0.005$). Dogs with moderately/severely stenotic nostrils (compared to open/mild) had a mean increase in BOAS index of 16%. The NGR was significantly associated with BOAS index ($p = 0.002$); a 0.01 increase in NGR increases BOAS index by 1.67% on average.

Bulldogs

(1) Inter-observer reproducibility of soft tape measurements.

The inter-observer variations in soft tape measurements are shown in S1 and S2 Tables (raw data can be found in S1 Data). Overall, most of the direct measurements and their ratios had poor to moderate agreement between the two observers except for CG. Among other ratios, only NGR had good inter-observer agreement with the estimated ICC = 0.81 (95%CI: 0.58 to 0.92) (Fig 3) and its eME was only a mere 3.7% (S1 Table).

(2) Soft tape measurement of conformation in relation to BOAS.

The summary of each soft tape measurement with BOAS functional grade can be seen in S3 Table. SW ($p<0.001$), EW ($p = 0.014$), and NG ($p<0.0001$) were significantly greater in BOAS (+) bulldogs, who also had significantly higher SI ($p<0.001$) and NGR ($p<0.0001$). Similar to the other two breeds, there are substantial overlaps in all ratios among different functional grades (S1 Fig).

(3) Full model of conformation, nostril stenosis and BCS predicting BOAS.

The results of the multivariate logistic regression model are shown in Table 3 (Raw data can be found in S2 Data). The final model for bulldogs contained six variables that accounted for 37% of the total variation in predicting BOAS (+). Bulldogs that were neutered had 8.1 times greater the odds of being BOAS (+). However, the 95% CI was wide (2.14 to 38.94), which is likely due to the higher proportion of dogs that were not neutered (91.5%). With regards to the obesity-related variables, BCS was significant in the model ($p = 0.022$) with odds ratio at 1.56 (95%CI: 1.07 to 2.3). Fig 4 demonstrates the distribution of BCS and degree of nostril stenosis against BOAS functional grade.

Fig 5 gives an indication of the effect of each conformational ratio on the probability of BOAS; depicting the univariate logistic curve fit to each ratio individually. In the final model (Table 3), SI ($p = 0.016$) and NGR ($p<0.0001$) were significantly associated with BOAS, with odds ratios of 1.05 (95%CI: 1.01 to 1.09) and 1.29 (95%CI: 1.18 to 1.43) for an increase of 0.01 in SI and NGR, respectively.

Fig 6 shows the predictive performance of the final model. The classification was based on a cut-off value of 0.5 (Fig 6A), which showed good accuracy in classifying BOAS (+) and BOAS (-) dogs with AUC of the ROC at 81% (95%CI: 75% to 87%).

In the final model, NGR was retained as a valid predictor in the model ($p<0.0001$) with good inter-observer agreement of the measurement (ICC = 0.81), as well as a significant predictor for BOAS index ($p = 0.001$). The mean NGR in male bulldogs (mean = 0.71) was significantly higher than that of female bulldogs (mean = 0.66, $t = -7.40$, $df = 170.9$, $p<0.0001$). The AUC of the ROC for NGR alone was 73% (95%CI: 61–84%) for male bulldogs, which indicates moderate accuracy in classifying BOAS (+) and BOAS (-) dogs. The cut-off NGR value was 0.71 with sensitivity of 71% and a specificity of 69%. NGR was less sensitive in female bulldogs than male bulldogs: the AUC was slightly lower in female at 70% (95%CI: 61–80%). With a cut-off NGR value at 0.66, the sensitivity was 71% and the specificity was lower at 61%.

(4) Validation of the model using BOAS index.

The BOAS (+) prevalence (functional grade II/III) was not significantly different between all study bulldogs and the bulldogs in the validation group (i.e. the ones that had BOAS index available) ($\chi^2 = 1.093$, $p = 0.296$). The results of the multivariate linear regression models can be found in Table 4 (raw data can be found in S3 Data). The adjusted R-squared value of the multivariate linear regression model was 0.26.

Neuter status ($p = 0.044$), stenotic nostrils ($p = 0.003$), and NGR ($p = 0.001$) were significantly associated with BOAS index. Compared to the intact bulldogs, the neutered bulldogs had a mean increase in BOAS index of 24%, although again the 95%CI was wide (1% to 47%). Dogs with moderately/severely stenotic nostrils (compared to open/mild) had a mean increase in BOAS index of 16% (95%CI: 6% to 27%). A 0.01 increase in NGR is associated with a mean increase of 2% (95%CI: 1% to 4%) in BOAS index.

Discussion

This study describes breed-specific models using several conformational factors to predict the probability of being BOAS-affected. The large sample size in the study supports that each ratio is reliable in population terms, and could guide the writing of breed standards, although the likelihood of inaccuracy in many of the individual measurement as shown by ICC and eME means that most of the individual limits cannot be set. The reliable measures, such as the NGR in bulldogs, and other easily accessible factors, such as nostril stenosis and BCS, may be of use for breeding selection.

Inter-observer agreement of conformational soft tape measurements

Sutter *et al.* (2008) reported that approximately 0.13% of soft tape measurements used in a multi-breed study were judged to be measurement errors, yet the actual inter-observer agreement of the measurements was not tested. Neither did the Packer *et al.* (2015) study investigating the conformational risk factors for BOAS describe measurement inter-observer agreement. Unfortunately, most of the conformational soft tape measurements in the present study had poor inter-observer agreement in all three breeds. The authors have found that performing tape measurements may be challenging on unsedated dogs, as measurements can be altered easily with slight changes in position (e.g. small changes in degree of the angle between the neck and the back or in head carriage when standing). In dogs with loose and thick skin and/or thick fat coverage it is particularly difficult to reproduce the measurements with good accuracy. Moreover, some of the dogs objected to facial measurements such as SnL. The measurements mentioned above showed large errors of up to 18.7% between two different trained observers and had poor inter-observer agreement according to ICC. These measurement errors directly affect the inter-observer agreement of the respective ratios. The inter-observer reproducibility of the CFR was worst in French bulldogs with the mean measurement errors over 22%. French bulldogs have highly variable over-nose skin fold patterns that affect this measure, whereas in the other two breeds, the type of fold was more uniform (a single fold). Among all the ratios, only CFR in pugs and NGR in bulldogs had reasonably good inter-observer agreement.

Breed-specific predictors for brachycephalic obstructive airway syndrome

In pugs, female dogs have a higher risk of developing BOAS than male dogs. Interestingly, in French bulldogs, the trend was the opposite. While male dogs are often used as stud dogs at an early age, postponing the decision to breed until the dog is older is recommended, as affected dogs may only show clinical signs in adulthood.

Stenotic nostrils were a significant predictor for BOAS in all three breeds, consistent with our previous findings [16]. Stenosis of the nostrils is the only BOAS airway lesion that can be easily diagnosed without sedation and/or specific equipment, such as an endoscope. The grading system proposed by the authors is straightforward and easily applicable by dog owners. Importantly, nostril stenosis may play a significant role in the severity of BOAS. Nasal breathing is predominant in dogs, even when the dog is panting, the majority of airflow passes through the nasal cavity during inspiration [34, 35]. Commonly, dogs with moderately/severely stenotic nostrils have immobile nostril wings during exercise. Whereas dogs with open/mildly stenotic nostrils usually have mobile nostril wings that can abduct further when needed [15]. Due to the restriction of airflow at the entrance of the

airway, dogs with stenotic nostrils can be prone to poor thermal regulation and may have an excessive increase in negative pressure within the airway. Stenotic nostrils are a particular issue in French bulldogs, in the present study, 45% of French bulldogs had severe stenosis of the nostrils. Since the impact of stenotic nostrils on BOAS is substantial, the responsible breeder should avoid using dogs with moderate/severe stenotic nostrils.

Obesity, as quantified using BCS, was a robust risk factor for BOAS, and this result is consistent with previous studies [16, 26]. The impact of obesity on respiratory function includes a decrease in minute volume with an increase in respiratory rate, exercise intolerance, and a decrease in estimated arterial oxygen saturation [16, 36, 37]. Interestingly, while BCS was a significant risk factor for BOAS in pugs and bulldogs, this was not the case in French bulldogs. Only 8.4% of French bulldogs were obese compared to 60.8% and 35.3% of pugs and bulldogs, respectively. About 15% of Grade III French bulldogs were underweight and all of these had frequent regurgitation. In addition to the possible anatomical abnormalities (e.g. oesophageal diverticula), the increase in thoracic negative pressure during respiratory distress could further trigger gastrointestinal signs such as regurgitation and vomiting as a result of gastro-oesophageal reflux and temporary hiatal hernia [38, 39]. Nevertheless, the impact of obesity on BOAS in French bulldogs should not be ignored. It was noted that the majority of the obese French bulldogs were BOAS (+) (Fig 4A).

BOAS, in many ways, is similar to human obstructive sleep apnoea (OSA) [40–43]. The effect of obesity on OSA has been investigated with different measurements. Recently, body mass index (BMI) z-score and neck-to-waist ratio were recognized as independent predictors of OSA [44]. Similar findings were shown in the current study for French bulldogs and bulldogs. Packer *et al.* (2015) have previously reported that a greater neck girth increased the risk of BOAS, but the NG to CG ratio was not significantly associated with BOAS. In the current study, both the absolute measurement of NG and NGR were significantly higher in BOAS (+) French bulldogs and bulldogs (S3 Table). The reason why NG and other direct measurements were not included in the initial models was that the measurements are significantly affected by body size and gender. Although gender was included in all models, the variation in size within the same gender should not be ignored. As the CG was comparable between the BOAS (-) and BOAS (+) dogs, it could be used as a reference to normalize NG. Neck fat accumulation is associated with severity of OSA in humans, and could cause a reduction in pharyngeal lumen diameter, further triggering collapse of the airway [45–49]. Unlike pugs and bulldogs, French bulldogs in our study tended to have an ideal BCS. High NGR in slim dogs could be caused by either fat or muscle. The actual relationship between the NGR and the impact on upper airway obstruction is unknown. Nevertheless, NGR is a strong and valid predictor of BOAS independently of other factors in bulldogs and it may be assumed that selection away from this phenotype will reduce the prevalence of BOAS. In French bulldogs, it was unexpected that the inter-observer agreement of NGR was poor when the measures of NG and CG were both reasonably reproducible. It was found that in some dogs, the observer-1 measured the NG longer but CG shorter than observer-2. Although the differences were not considerable for both of the measurements, the accumulated errors have a significant impact on NGR measurement inter-observer agreement.

Other conformational factors such as SI and EWR in pugs, and NLR in French bulldogs were significantly associated with BOAS in the final models, after adjusting for other factors such as gender. However, not only did these measurements have poor inter-observer agreement, they were also not significantly associated or only marginally associated with the BOAS index. Therefore, the measurements may not be valid for predicting individual BOAS-affected dogs at this stage. However, it is possible, that by introducing more reliable measurement methods these factors may be used as valid predictors for BOAS (+) in the future.

Craniofacial ratio and brachycephalic obstructive airway syndrome

A previous study suggested that BOAS risk increases in dogs with relatively shorter muzzles (craniofacial ratio, CFR) and thicker necks, across different brachycephalic breeds: from extreme brachycephalic breeds such as the pug (median CFR = 0.08) to moderate brachycephalic breeds such as the Staffordshire Bull Terrier (median CFR = 0.5) [26]. In our study with large numbers of dogs of the three breeds, we obtained supportive data on NGR, but only a weak association of BOAS status with CFR in a single breed. Within breeds, the variations in CFR were very limited. CFR overlapped considerably between the different BOAS functional grades. Our findings on the reproducibility of these measures and the large differences in detailed conformation between brachycephalic dog breeds suggest that the true associations between CFR and BOAS for specific breeds may not be comparable to the findings in the Packer *et al.* (2015) study that compared multiple breeds with, in most cases, relatively small numbers of dogs. Anatomically, the CFR measurement cannot determine the main internal BOAS lesions along the upper airway. Fig 7 illustrates the position at which CFR measurements are made, in comparison to the position of the internal lesions of BOAS. For extreme brachycephalic dogs, the SnL only includes the region of the nasal planum and nasal vestibule, while other common BOAS lesions such as overcrowded and aberrant nasal turbinates, elongated soft palate, and macroglossia underlie the CL. Therefore it is questionable that having higher CFR would effectively decrease the risk of BOAS for all individuals in the current population. Instead, airway crowding will occur both for individuals with a short facial length and for individuals with a short cranium, so that the most severely affected CFR is not predictable. In dogs that had CFR higher than the third upper-quartile (CFR > 0.19), 46% were still BOAS (+). In contrast to this result, it is more encouraging that among the dogs that had open/mildly stenotic nostrils, only 25% of them were BOAS (+) whereas among the dogs that had moderately/severely stenotic nostrils, 70% of them were BOAS (+). When considering a more effective criterion to assist in breeding away from BOAS, it is likely that the nostril grading would be superior to CFR.

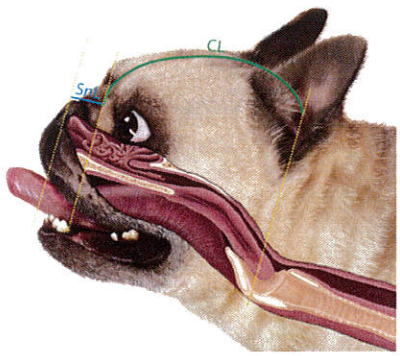

Fig 7. An illustration demonstrates the relationship between the external craniofacial ratio (CFR) measurement and the corresponding internal anatomical structures of the upper airway.

The realistic anatomical illustration was made according to a computed tomographic 3-dimensional rendering image of a French bulldog. The illustration was reprinted from the Cambridge BOAS research group website (http://www.vet.cam.ac.uk/boas) under a CC BY license, with permission from the group in the University of Cambridge, original copyright 2016.
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Limitations of the study

There are several limitations to this study. Firstly, only about half of the study population had an available BOAS index, which markedly reduces the power to validate the final model. Secondly, the study was conducted over three years. It might be possible that the investigators gradually gained more experience on measuring the dogs over time. It should be noted though that the reproducibility measurements were performed towards the end of the study. It is also possible, though unlikely, that the trend of the conformation changed over the study period. Thirdly, as all study dogs were recruited from the UK, the results may have limited significance on these breeds in other regions of the world.

Conclusion

Nostril stenosis is a strong predictor of BOAS for all three breeds. Dogs with moderate to severe stenosis of the nostrils were at higher risk of developing BOAS. BCS is significantly associated with BOAS in pugs and bulldogs with obese dogs having a higher risk of being BOAS (+). Among the conformation measurements, NGR is a valid predictor of BOAS in male bulldogs and highly reliable between different observers, thus it could potentially be used for breeding selection. EWR and SI in pugs, and NGR and NLR in French bulldogs, SI in bulldogs, were associated with BOAS but had poor-moderate inter-observer reproducibility. Nevertheless, they may be of use for directing the reformation of breed standards.

Overall, the conformational and external factors as measured here contribute less than 50% of the variance that is seen in BOAS. The authors strongly suggest using these in conjunction with regular clinical assessment of respiratory signs before and after exercise (BOAS Functional Grading). More importantly, breeding toward extreme brachycephalic features should be strictly avoided.

Supporting information

S1 Table. The results of the inter-observer mean measurement errors of the conformational soft tape measurements.
https://doi.org/10.1371/journal.pone.0181928.s001
(DOCX)

S2 Table. The results of the inter-observer agreement of the conformational soft tape measurements.
https://doi.org/10.1371/journal.pone.0181928.s002
(DOCX)

S3 Table. Comparison of conformational soft tape measures between BOAS (-) and BOAS (+) dogs.
https://doi.org/10.1371/journal.pone.0181928.s003
(DOCX)

S1 Fig. Boxplots show the distribution of the five conformation ratios against BOAS functional grades.
The x-axis is BOAS functional grade; the y-axis is the ratios in percentage. CFR, craniofacial ratio; EWR, eye with ratio; SI, skull index; NGR, neck girth ratio; NLR, neck length ratio.
https://doi.org/10.1371/journal.pone.0181928.s004
(TIF)

S1 Data. Raw data for the reproducibility tests of soft tape measurements.
https://doi.org/10.1371/journal.pone.0181928.s005
(XLSX)

S2 Data. Raw data for the full model.
https://doi.org/10.1371/journal.pone.0181928.s006
(XLSX)

S3 Data. Raw data for the validation model.
https://doi.org/10.1371/journal.pone.0181928.s007
(XLSX)

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Whole-Body Barometric Plethysmography Characterizes Upper Airway Obstruction in 3 Brachycephalic Breeds of Dogs

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Background: A novel test using whole-body barometric plethysmography (WBBP) was developed recently to diagnose brachycephalic obstructive airway syndrome (BOAS) in unsedated French bulldogs.

Hypothesis/Objectives: The hypotheses of this study were: (1) respiratory characteristics are different between healthy nonbrachycephalic dogs and brachycephalic dogs; and among pugs, French bulldogs, and bulldogs; and (2) obesity and stenotic nares are risk factors for BOAS. The main objective was to establish a diagnostic test for BOAS in these 3 breeds.

Animals: A total of 266 brachycephalic dogs (100 pugs, 100 French bulldogs, and 66 bulldogs) and 28 nonbrachycephalic dogs.

Methods: Prospective study. Exercise tolerance tests with respiratory functional grading, and WBBP were performed on all dogs. Data from WBBP were associated with functional grades to train quadratic discriminant analysis tools to assign dogs to BOAS+ and BOAS- groups. A BOAS index (0–100%) was calculated for each dog. Receiver operating characteristic (ROC) curves were used to evaluate classification ability.

Results: Minute volume was decreased significantly in asymptomatic pugs ($P = .009$), French bulldogs ($P = .026$), and bulldogs ($P < .0001$) when compared to nonbrachycephalic controls. Respiratory characteristics were different among breeds and affected dogs had a significant increase in trace variation. The BOAS index predicted BOAS status for each breed with 94–97% (95% confidence interval [CI], 88.9–100%) accuracy (area under the ROC curve). Both obesity ($P = .04$) and stenotic nares ($P = .004$) were significantly associated with BOAS.

Conclusions and Clinical Importance: The WBBP can be used as a clinical tool to diagnose BOAS noninvasively and objectively.

Key words: Brachycephalic obstructive airway syndrome; Quadratic discriminant analysis; Respiratory function test; Whole-body barometric plethysmography.

Brachycephalic obstructive airway syndrome (BOAS) is common among extremely brachycephalic breeds of dogs.[1,2] Physical examination, history, and lesion assessment under sedation or general anesthesia are used to diagnose BOAS.[3] These methods however are either subjective or invasive, which creates difficulty when evaluating disease progression and the effectiveness of treatment in a clinical setting. Hence, development of new methods for non-invasive and objective measurements of respiratory function in affected dogs is crucial.

The use of pneumotachographs along with analysis of tidal breathing flow volume loops (TBFVL), as well as the forced oscillation technique, have allowed previous measurement of respiratory function in conscious dogs and detection of airway obstructions.[4–6] However, these techniques require use of a tight-fitting facemask attached to the pneumotachograph, which is particularly difficult to apply to a brachycephalic dog's muzzle without having air leakage or causing stress in untrained dogs. Whole-body barometric plethysmography (WBBP) is a non-invasive technique of measuring respiratory function that has been validated and utilized

Abbreviations:

AIC	Akaike's information criterion
BCS	body condition score
BOAS	brachycephalic obstructive airway syndrome
BW	body weight
CI	confidence interval
EMMS	electromedical measurement systems
ETT	exercise tolerance test
MV	minute volume
OR	odds ratio
PEF	peak expiratory flow rate
PENH	enhanced pause
PIF	peak inspiratory flow rate
QDA	quadratic discriminant analysis
ROC	receiver operating characteristic
RR	respiratory rate
RT	relaxation time
SD	standard deviation
TBFVL	tidal breathing flow volume loops
Te	expiratory time
Ti	inspiratory time
TV	tidal volume
WBBP	whole-body barometric plethysmography

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Table 3. The baseline respiratory parameters in nonbrachycephalic control dogs and Grade 0 pugs, French bulldogs, and bulldogs.

	Nonbrachycephalic controls (n = 28)	Grade 0 pugs (n = 7)	Grade 0 French bulldogs (n = 10)	Grade 0 bulldogs (n = 10)
Obesity (%)	0%	28.57%	0%	20%
Stenotic nares (%)	0%	14.29%	0%	0%
RR_m	20.81 (16.95–25.02)‡	22.50 (16.81–24.1)	23.16 (21.82–29.85)*	23.46 (19.81–28.13)
TV/BW_m	11.64 (9.71–12.85)‡‡,§§§	10.17 (8.55–13.11)§§	8.59 (7.83–10.32)**	6.66 (6.05–8.18)***,††
MV/BW_m	233.42 (224.56–254.69)††,‡,§§§	217.57 (190.57–219.95)**,§§	211.14 (190.33–235.11)*	176.97 (140.52–183.51)***,††,‡‡
Te/Ti_m	1.37 (1.28–1.55)‡‡‡,§§§	1.29 (0.83–1.66)	0.90 (0.82–1.12)***	0.95 (0.81–1.20)***
PIF/BW_m	16.40 (13.72–18.11)‡‡‡,§§§	13.68 (12.55–15.92)§§	11.90 (10.07–12.80)***	9.83 (8.10–10.56)***,††,‡
PEF/BW_m	13.42 (10.92–14.75)§§§	12.15 (10.99–14.84)§§	11.92 (11.19–13.46)	8.38 (7.07–9.94)***,††,‡‡
PEF/PIF_m	0.83 (0.75–0.89)‡‡‡,§	0.89 (0.81–1.12)	1.02 (0.96–1.10)*	0.90 (0.83–0.98)*,‡
RR_sd	2.14 (1.49–2.76)	2.85 (2.09–3.79)	2.37 (2.05–3.09)	2.73 (1.38–3.27)
TV/BW_sd	1.45 (1.22–1.82)§§	1.73 (1.17–1.85)§	1.35 (1.06–1.62)	0.82 (0.69–1.06)**,†,‡
MV/BW_sd	24.64 (15.09–31.19)§	23.95 (13.92–28.10)	25.23 (16.32–37.02)	14.52 (11.31–22.56)*,‡
Te/Ti_sd	0.24 (0.17–0.32)‡,§	0.32 (0.22–0.36)‡,§	0.16 (0.13–0.24)*,††	0.14 (0.11–0.22)*,†
PIF/BW_sd	1.89 (1.51–2.65)‡,§§	1.85 (1.40–2.70)§	1.42 (1.20–1.86)*	1.05 (0.79–1.74)**,†
PEF/BW_sd	1.93 (1.48–2.55)§	2.39 (1.90–2.72)§	1.92 (1.57–2.41)	1.33 (0.86–1.92)*,†
PEF/PIF_sd	0.11 (0.09–0.12)†	0.19 (0.08–0.21)*	0.13 (0.12–0.17)	0.11 (0.08–0.14)

Data are presented as median with interquartile range.

RR = respiratory rate (breath/minute); Te/Ti = expiratory time (s)/inspiratory time(s); PEF/PIF = peak expiratory flow rate (ml/s)/peak inspiratory flow rate (mL/s); MV/BW = minute volume (mL)/body weight (kg); m = mean of the parameter calculated from the 20 breaths of each dog; sd = standard deviation of the parameter calculated from the 20 breaths of each dog.

*Significantly different from the non-brachycephalic controls $P(\text{raw}) < .05$; **$P(\text{raw}) < .01$; ***$P(\text{raw}) < .0001$.

†Significantly different from the Grade 0 pugs at $P(\text{raw}) < .05$; $^{\dagger\dagger}P(\text{raw}) < .01$.

‡Significantly different from the Grade 0 French bulldogs at $P(\text{raw}) < 0.05$; $^{\ddagger\ddagger}P(\text{raw}) < 0.01$; $^{\ddagger\ddagger\ddagger}P(\text{raw}) < 0.001$.

§Significantly different from the Grade 0 bulldogs at $P(\text{raw}) < 0.05$; $^{\S\S}P(\text{raw}) < 0.01$; $^{\S\S\S}P(\text{raw}) < 0.001$.

no interactions between any of the factors. Obesity had a negative effect on the means of all the volume-related respiratory parameters (ie, TV/BW_m, MV/BW_m, PIF/BW_m, PEF/BW_m), but had no significant effect on the SD of any respiratory parameters. Age was not significantly associated with BOAS status. Stenotic nares were significantly associated with BOAS status in Pugs ($\beta = 1.46$, OR = 4.3, 95%CI = 1.69–10.97, $P = .002$), French bulldogs ($\beta = 2.97$, OR = 19.56, 95% CI = 5.48–69.80, $P < .0001$), and bulldogs ($\beta = 1.15$, OR = 3.147, 95%CI = 1.05–9.45, $P = .011$). After adjusting for the stenotic nares, male dogs were more likely to be affected if they were French Bulldogs ($\beta = 1.82$, OR = 6.17, 95%CI = 1.68–22.67, $P = .006$) or Bulldogs ($\beta = 1.50$, OR = 4.49, 95%CI = 1.44–14.05, $P = .01$), but not if they were pugs.

Quadratic Discriminant Analysis (QDA) to Classify BOAS Status

Classification results using the BOAS index for each model are presented in Table 5 and Data S3. The ROC curves derived from each BOAS index are shown in Fig 4. Each of the 3 breed-specific models, Model (PD), Model (FB) and Model (BD), had better classification results than the general model, Model (PFB). Nevertheless, positive predictive values in all models were >90%, and all final ROC curves had good or excellent discrimination: area under the curve (AUC) = 91.2% (95%CI: 87.5–94.8%) for Model (PFB), AUC = 93.9% (95%CI: 88.9–98.9%) for Model (PD), AUC = 97.2% (95%CI: 94.1–100%) for Model (FB), and AUC = 97.0% (95% CI: 91.2–100%) for Model (BD). The best cut-off points for the breed-specific models (BOAS index = 55.38% in pugs, 49.41% in French bulldogs, and 43.53% in bulldogs) were similar to the original classification setting (BOAS index = 50%), whereas the cut-off points on Model (PFB) for each breed varied (49.90% in pugs, 66.37% in French bulldogs, 31.11% in bulldogs). The overlap of BOAS index between Grade 0/I and Grade II/III dogs in this model can be clearly seen in Data S3, but is decreased by specifying different cut-off points for each breed.

Discussion

We have developed a tool that allows quantification of BOAS severity utilizing the respiratory variables obtained from WBBP in unrestrained brachycephalic dogs. The baseline respiratory characteristics were significantly different among asymptomatic pugs, French bulldogs, bulldogs, and nonbrachycephalic breeds. In addition, the proposed BOAS index can distinguish BOAS-affected and clinically healthy brachycephalic dogs using breed-specific models. Obesity and stenotic nares in brachycephalic dogs are highly associated with BOAS.

Ours is the first study on respiratory function in BOAS-predisposed breeds that recruited a large number of both affected and clinically healthy dogs. BOAS has a high prevalence in all 3 breeds, but it often is unrecognized. In this study, approximately 40–50% of the

Table 4. The differences in respiratory parameters between BOAS functional Grade 0/I and Grade II/III brachycephalic dogs, and the effect of obesity on respiratory parameters.

	Grade 0/I Brachycephalic Dogs (n = 114)[a]	Grade II/III Brachycephalic Dogs (n = 152)[b]
Obesity (%)	28.95%	43.42%
Stenotic nares (%)	31.37%	74.65%
RR_m	22.46 ± 5.03	22.12 ± 4.57
TV/BW_m	9.25 ± 2.49	10.28 ± 3.33**,†
MV/BW_m	195.81 ± 31.73	218.60 ± 67.18***,††
Te/Ti_m	1.08 ± 0.27	1.10 ± 0.31
PIF/BW_m	11.77 ± 2.52	13.58 ± 4.46***,††
PEF/BW_m	11.17 ± 2.66	17.58 ± 8.46**,††
PEF/PIF_m	0.96 ± 0.14	1.32 ± 0.43*
RR_sd	2.74 ± 0.94	3.12 ± 1.16**
TV/BW_sd	1.44 ± 0.58	1.95 ± 0.82***
MV/BW_sd	22.87 ± 8.49	35.15 ± 15.09***
Te/Ti_sd	0.21 ± 0.10	0.39 ± 0.15***
PIF/BW_sd	1.64 ± 0.76	2.39 ± 1.25***
PEF/BW_sd	1.79 ± 0.74	3.78 ± 2.14**
PEF/PIF_sd	0.13 ± 0.06	0.30 ± 0.16**

A linear mixed model was used with level 1 individual dog and level 2 breeds (random effect). Data are presented as mean ± standard deviation.

RR = respiratory rate (breath/minute); Te/Ti = expiratory time (s)/inspiratory time(s); PEF/PIF = peak expiratory flow rate (mL/s)/peak inspiratory flow rate (mL/s); MV/BW = minute volume (mL)/body weight (kg); m = mean of the parameter calculated from the 20 breaths of each dog; sd = standard deviation of the parameter calculated from the 20 breaths of each dog.

[a]Grade 0/I pugs = 33, Grade 0/I French bulldogs = 44, Grade 0/I bulldogs = 37.

[b]Grade II/III pugs = 67, Grade II/III French bulldogs = 56, Grade II/III bulldogs = 29.

*Significantly different from the BOAS− dogs at $P < .05$; **$P < .01$; ***$P < .001$.

†Obesity has a significant negative effect on the respiratory parameter at $P < .05$; ††$P < .01$.

respiratory changes seen in clinically healthy brachycephalic dogs will cause long-term secondary effects on health such as gastrointestinal disorders, metabolic changes, or other problems.[34,35] Large studies on gastrointestinal disorders in healthy brachycephalic dogs are needed. Hypomagnesemia and hypercoagulation were found in clinically healthy bulldogs compared to nonbrachycephalic control dogs and boxers.[36,37] Hypertension also was reported in systemically healthy pugs, Boston terrier, French bulldogs, and bulldogs.[38] These findings support the argument that the bulldog is a natural model for sleep apnea and hypopnea syndromes in humans with similar metabolic changes.[29]

Respiratory Characteristics in Grade II/III pugs, French Bulldogs, and Bulldogs

Grade II/III dogs are "awake snorers" with increased respiratory noise after exercise and labored breathing. Loss of constancy in the breathing pattern is an obvious change in respiration in BOAS (Fig 3C). In Grade II/III dogs, the breathing appears more chaotic and requires continuous adjustment, which contrasts with the consistent airflow patterns seen in Grade 0/I dogs (Fig 3B). The TBFVL of BOAS-affected bulldogs has been recorded.[5] The study commented that the most common loop shape in brachycephalic dogs was characterized by a flattened (fixed-type obstruction) or a rounded expiratory phase (nonfixed-type) with a flattened inspiratory phase. The loop often contained bursts of high frequency flow oscillations during inspiration and occasionally during expiration. The WBBP flow traces of a bulldog were collected before and after surgery,[11] and were similar to the Type B Bulldog BOAS traces in this study. So far, interpretation of the flow waveforms in BOAS-affected dogs remains unclear. As can be seen in Fig 3C, flow waveforms of Grade II/III dogs in all 3 breeds are not uniform. Nevertheless, 1 of the advantages of using QDA is that its quadratic boundary allows inclusion of different types of traces into the models.

The BOAS Index is an Useful Tool to Discriminate Objectively between Affected and Clinically Healthy Pugs, French Bulldogs, and Bulldogs

Marked variations of respiratory characteristics in Grade II/III dogs, not only among breeds but also within breeds, were observed in this study. Such variations were taken into account in the QDA classifier, which finds a novel application in characterizing respiratory flow traces. The QDA is a classic classifier with a quadratic decision surface, generated by fitting class conditional densities to the data and using Baye's rule to perform predictions.[32] In our previous study on French bulldogs, a training group, approximately 60 dogs, was evaluated by a test dataset and found to have good sensitivity and specificity.[18] We thus used a minimal number of 60 dogs to train the QDA classifier. We further used the caudal probabilities generated from QDA to calculate a predictive BOAS index. The BOAS index proposed here is a numeric scale to quantify the relative severity of BOAS. Our previous study of 89 French bulldogs showed that once the model is trained, QDA could accurately classify new dogs.[18] After a preliminary test using a test dataset (20% of the total dog number), an internal permutation test was performed to validate the final models presented in this study. The finding that the discriminant performance is better when we use breed-specific instead of general models is consistent with the differences that exist in the respiratory pattern and anatomy of the 3 breeds. Positive predictive values are all >94% in the 3 breed-specific models. The protocol to collect WBBP data, process the data, and generate the BOAS index is straightforward and can be widely used in general practice with minimal staff training.

Obesity and Stenotic Nares are Associated with BOAS

Obese brachycephalic dogs have a higher risk of being BOAS-affected, and obesity has a significant effect

Table 5. Classification results of BOAS− and BOAS+ in pugs, French bulldogs, and bulldogs using quadratic discriminant analysis (QDA).

	Model (PD)	Model (FB)	Model (BD)	Model (PFB)
Prevalence	67% (CI_{95}: 56.88–76.08%)	56% (CI_{95}: 45.72–65.92%)	43.94% (CI_{95}: 31.74–56.70%)	57.14% (CI_{95}: 50.96–63.17%)
Sensitivity	88.06% (CI_{95}: 77.82–94.70%)	94.64% (CI_{95}: 85.13–98.88%)	89.66% (CI_{95}: 72.65–97.81%)	80.92% (CI_{95}: 73.76–86.83%)
Specificity	93.94% (CI_{95}: 79.77–99.26%)	93.18% (CI_{95}: 81.34–98.57%)	100% (CI_{95}: 90.51–100%)	92.98% (CI_{95}: 86.64–96.92%)
Positive predictive value	96.72% (CI_{95}: 88.65–99.60%)	94.64% (CI_{95}: 85.13–98.88%)	100% (CI_{95}: 86.77–100%)	93.89% (CI_{95}: 88.32–97.33%)
Negative predictive value	79.49% (CI_{95}: 63.54–90.70%)	93.18% (CI_{95}: 81.34–98.57%)	92.50% (CI_{95}: 79.61–98.43%)	78.52% (CI_{95}: 70.63–85.12%)
Positive likelihood ratio	14.53 (CI_{95}: 3.78–55.83)	13.88 (CI_{95}: 4.65–41.46)	N/A*	11.53 (CI_{95}: 5.89–22.59)
Negative likelihood ratio	0.13 (CI_{95}: 0.07–0.24)	0.06 (CI_{95}: 0.02–0.17)	0.10 (CI_{95}: 0.04–0.30)	0.21 (CI_{95}: 0.15–0.29)

Model (PD): breed-specific model based on 100 Pugs. Model (FB): breed-specific model based on 100 French Bulldogs. Model (BD): breed-specific model based on 66 Bulldogs. Model (PFB): general model based on 266 brachycephalic dogs (100 Pugs, 100 French Bulldogs, and 66 Bulldogs).

CI_{95} = 95% confidence interval.

*Not calculable as specificity = 1.

on decreasing TV/BW and MV/BW as well as PIF/BW and PEF/BW. Flow limitation during both inspiratory and expiratory phases suggests that obesity worsens respiration in brachycephalic dogs. An increase in soft tissue abutting the fixed bony structures results in a decreased airway lumen and increased stiffness of the respiratory system, which limits lung expansion.[39,40] Similarly, experimental beagles had significantly decreased TV/BW and significantly increased RR after being fed to obesity.[19] The TV/BW often is decreased in severely obese humans, and breathing follows a rapid, shallow pattern with significant decreases in PEF/BW.[39,41] We have not separated the effects of obesity and other conformational effects associated with brachycephaly on respiratory function because there were insufficient obese Grade 0 dogs in each breed. Therefore, further study into changes in respiratory function after weight loss in brachycephalic dogs is warranted. In this study, obesity was defined based on BCS. In human medicine, in addition to the use of body mass index as an indication of obesity when investigating associations between obesity and obstructive sleep apnea, measurements of waist circumference (central obesity), neck circumference, deposition of fat around specific parts of the body such as neck or the base of the tongue were reported.[42–46] Additional studies on the predictive obesity-related parameters that may increase the risk of developing BOAS are required.

Until now, it has been difficult to distinguish in BOAS the functional consequences of each individual anatomic change associated with brachycephaly. Our study shows that severe stenosis of nares in brachycephalic dogs is a very important contributor to (by restricting airflow), or consequence of BOAS (through further collapse after a period of chronic high negative pressure within the airway). For French bulldogs in particular, the risk of BOAS in dogs with stenotic nares increases about 20 times. This breed previously has been shown to be at particular risk of mucosal contact points between the plica recta and nasal septum.[28] The Starling resistor model[47] equates airway function to a hollow tube with a constriction within the nasal cavity and near the nostrils, and a caudal collapsible segment, the oropharynx. This model predicts that a nose obstruction upstream will generate a negative intraluminal pressure downstream at the oropharynx, resulting in pharyngeal collapse.[48] Even when the dog breathes orally, the majority of inspired air passes through the nose, and the expired air goes through the mouth, both during shallow thermal panting and deep panting.[49,50] Therefore, nasal obstructions not only restrict the airflow during nasal breathing at rest but also affect thermal regulation during panting in dogs.

Limitations

This study has several limitations. First, the prevalence of BOAS observed here reflects a mixed group of clinical cases and volunteer dogs and may not represent the true prevalence in the 3 breeds. However, it does not affect the aim of this study because both the numbers of affected dogs and clinically healthy dogs are sufficient for QDA. Second, we have not separated the effects of obesity and BOAS on respiratory function because there were insufficient obese Grade 0 dogs in each breed. Therefore, further study of the changes that occur in respiratory function after weight loss in brachycephalic dogs is warranted. Third, only the clinical dogs had computed tomography scans of the thorax to exclude lower airway disease. Invasive diagnostic assessments (eg, radiography, CBC, and serum biochemistry panel) on volunteer study dogs were not possible because of ethical considerations. For these dogs, lower airway disease was ruled out based on history

Appendix B: Notes from NAWAC meeting May 2019

Notes on the NAWAC meeting 22 May 2019

I attended and presented to the NAWAC group yesterday. Pat Dance also attended with me as a representative for Pedigree DogsNZ.

DogsNZ

Steven Thomson and Becky Murphy attended for DogsNZ and presented first.

The DogsNZ presentation concentrated on matters intended to respond to the NAWA Opinion on Selective Breeding. I made a few notes:

a. The Brachycephalic Working Group has been extended to include more brachycephalic breeds, 8 in total.
b. DogsNZ are developing a Best Dog education framework for Judges and engaging with the NZ Judges to ensure they can assess and identify issues with breathing, eyes, diameter (weight), other exaggerated traits and gait.
c. The DogsNZ Code of Conduct had been established and was mandatory with penalties and fines for noncompliance. There were however options for seeking exemptions for all requirements bar the requirement that a bitch have only 6 litters in her lifetime.
d. The Bulldog Standard – has been reviewed by the Canine Health and Welfare Committee and recommendations have been made to change to either the FCI or the revised UK standard. The clubs have been given the chance to vote on one or the other. The standard will be changed to one of the options by August 2019.
e. DogsNZ is working with Massey University which will be providing the BOAS chamber for use both at the university and at shows.
f. The development of Litter Registration Limitations (**LRL**) with Labrador and Rottweiler Clubs and Breeders having voted in support and the German Shepherd and Pug Clubs and breeders to come. The Labrador LRL had shown significant success with the removal of DNA based issues. LRL's once in pace were mandatory and if breeders did not comply their litters would not be registered and they could leave. This ensures that DogsNZ can have control ensure health through the registry.
g. The concept of Fit for Function – Fit for Life has been developed.
h. A guideline for interpreting breed standards has been developed.

Feedback from NAWAC to the DogsNZ presentation was supportive noting that much had been done to respond to their opinion, more then other groups.

Questions raised were:

a. What was the percentage of dog breeders/owners that DogNZ had an influence over?
   DogsNZ Answer: 15% of breeders nationally are registered members of DogsNZ
b. What is DogsNZ planning to do about the ones they don't have influence over?
   DogsNZ Answer: Don't know.
   At the moment we are in the pedigree business.
   Pats Answer: Pedigree DogsNZ is engaged and talking to breeders and the public alike at pet expos and on dog walks. They have many educational resources about owning and buying healthy dogs and registering with DogsNZ that they hand out.
c. Follow up question: What about the cross-breed register that DogsNZ has?

DogsNZ Answer: That is available to cross bred dogs and is an option for registration with the incumbent obligations under the DogsNZ rules and regulations applying to both registered pedigree and crossbred dogs.

d. Had DogsNZ seen the HUHANZ petition and media articles about puppy farms?
DogsNZ Answer: No (Information to be provided to DogsNZ)
My Answer: I had seen the HUHANZ petition and the proposal to register breeders. I noted that there was a registry for breeders through DogsNZ and that registered breeders were regulated through the DogsNZ Rules and Regulations. It was accessible and clear.

Bulldog Club Taskforce

I had a short time to present so I spoke briefly and invited questions for Pat as a representative of Pedigree Dogs NZ and a pedigree breeder and I. In addition, I provided handouts of the full presentation and supporting documents.

I concentrated on key points:

1. The emphasis of the Clubs has been advocacy and education. To this end they have:
    a. joined as Clubs to work collaboratively for the betterment of our breeds. This includes a common code of conduct between all the Clubs. While reflecting the points in the DogsNZ Code of Conduct there are other matters that are specific to our breeds that we would also like to include.
    b. engaged and consulted with Club members and breeders on key issues this includes the breed standards. The British Bulldog Breed Standard is currently being consulted on.
    c. worked with breeders and vets to develop a health scheme for each of our breeds and to improve the overall health of our dogs.
    d. developed resources to help breeders and potential pet owners with key issues such as:
        a. what a responsible breeder is and the questions to ask when considering whether a bulldog or Frenchie is the right breed for you and who you want to buy one from;
        b. what should be in information packs including health and helpful information for new owners; and
        c. template contracts that breeders can use.
    e. engaged with the public at dog shows, expos, pet walks and on social media.
    f. advocated and engaged with key stakeholders including yourselves, officials and the minister, trademe and insurance companies to build relationships and an understanding of the work we are doing and to understand the issues.

I also commented on key issues for our clubs and the issues raised by HUHANZ and the SPCA in the media recently:

1. Bulldog Breed Standard:
    The proposed changes are currently being consulted on by the Clubs with their members. While I don't want to presume what their views will be. I think the issues we face cannot be put down to a breed standard alone. It is subjective and therefore subject to interpretation.

    DogsNZ has developed language which will help with the interpretation of breed standards as a whole. Our Breed Standards with the addition of guidelines to interpretation do not place aesthetics over health. Bulldogs and French Bulldogs bred to the Breed Standard can and are Healthy.

More widely it is the work on health testing and education that will improve Bulldog health. Speaking to other health co Ordinator's in the UK they have said that changes to breed standards in their countries have not had the effect that long-term health testing and developments in health have had. In the UK there has been over 10,000 bulldogs through the scheme that has to have an effect on the breeds health overall.

2. Responsible Breeders:
   The Clubs recognise that there are concerns and we share them when we see articles about puppy mills and pet stores. The clubs are responding to these issues with a range of tools and will continue to do so.

   We have been:

   - Developing educational resources such as what responsible breeders look like and the questions the public should ask when considering buying from a breeder.
   - Health testing certificates that breeders can show and advertise to confirm they have met testing requirements.
   - Information packs for pet owners and clear concise contracts focussed on welfare and not just payment.
   - A common code of conduct including common expectations of care and breeding that the Clubs and responsible breeders as a whole can promote.

   Our resources and messages on responsible breeders and breeding are strongly promoted on social media and in large groups where potential pet owners are seeking information. Those messages have been out there among our groups for a few years now and we are seeing at least with our breeds more people asking questions when buying pups and dogs. We of course cannot force the public to take that advice but we can but try.

3. Breeder Registration and Regulation:

   Responding to the question from the NAWAC member I said we have seen recent media statements including the HUHANZ petition and the interview with the SPCA a few weeks back. We understand the push to improve. However, breeders such as myself are already registered under DogsNZ. We are visible and accessible. We have rules we must comply with we are regulated.

Questions raised were:

a. There seems to be duplication between what the clubs are doing and what DogsNZ are doing?
   DogsNZ Answer: Our approach is to use the mandatory testing provided through the LRL. That testing is quality controlled with the NZVA and Massey and transparent. If breeders don't want to comply with an LRL on their breed, they can leave.

   My Answer:
   While there are common features in the health testing and code of conduct for example. The clubs are focussed on developing resources for their two breeds and promoting breed specific tools for our breeder members and our educational resources for the public.

   On the issue of the club health testing schemes, our approach is to build support among our breeders for health testing. We do not want to make the entry so hard that we lose the breeders who are new or aren't sure where to start with testing and who will benefit from our

health schemes and resources. If we do that, we lose an opportunity to improve the health of our breeds.

Like the Rottweiler breeders we may with time and breeder and club support get to an LRL but for now we want to encourage breeders to join and test for the entire dog and not one issue alone.

We have and are working with a number of vets including those with significant brachy practices to develop our Health schemes. We are focussed to ensure that testing is accessible to all our breeders on both islands. We also want to build public knowledge to ask for health tested dogs as well.

Framework for action on animal welfare in New Zealand

Context

- Two independent advisory committees.
- A national Animal Welfare Strategy – Care of animals, reputation for integrity.
- Regulation development and implementation – improving clarity and enforceability of our codes.
- *Safeguarding our Animals, Safeguarding our Reputation* outreach programme.
- An animal welfare system improvement work programme.

Where to

New Zealand will be world leading in animal welfare

Independent Voice	Transparency	Strengthening Codes	Capacity Building
An independent voice to ensure advice on animal welfare is future-thinking, timely, trusted and well-informed.	**Everyone knows what and why decisions are made, and has opportunities to participate in setting standards for the future of animal welfare.**	**Codes are focused on lifting standards beyond the minimum, they are understood, and they are underpinned by effective monitoring and compliance.**	**People in charge of animals believe animal welfare matters, and have the skills and capacity to meet animal welfare standards.**

What we can do

Independent Voice

Explore options to establish a voice for animals that is independent of the government, for example, a commissioner for animals.

Establish a cross-party animal welfare working group within Parliament.

Ensure that independent advisory committees are supported in their role as an independent voice, including ensuring that their membership is appropriately representative.

Transparency

Identify animal welfare information collected by MPI that can be reported and make it publically available. Encourage stakeholders to do the same.

Ensure greater participation of all interest groups, including the advocacy perspective, in standard setting.

Challenge industry to better engage with animal advocacy groups and understand their concerns.

Ensure independent advisory committees focus on more effective engagement with the public, including well-advertised public committee meetings.

Strengthening Codes

Understand why people offend and why offending is not always reported.

Review the use of animals in entertainment.

Continued focus on breeding standards for companion animals.

Review the *Safeguarding our Animals, Safeguarding our Reputation* programme to ensure effective education, monitoring, and compliance.

Codes of Welfare
- promote best practice within codes, for example through education and recognising good operators; and
- ensure positive welfare is considered when developing codes of welfare and regulatory proposals.

Regulations
- deliver regulations relating to the care and humane treatment of animals, including the Implementation Programme for Animal Welfare Regulations, and monitoring and evaluating the impact of the regulations; and
- deliver regulations that minimise the impact associated with surgical and painful husbandry procedures.

Use of animals in researching, testing and teaching
- review the operation of research, testing, and teaching in the Animal Welfare Act 1999; and
- lift the prestige and awareness of the 3R's Awards – supporting work that promotes the replacement, reduction, and refinement of animals used in research, testing, and teaching.

Capacity Building

Bring the focus back to good animal husbandry, and ensure sufficient capacity across government and all animal sectors to ensure this.

Develop partnerships within communities by linking in with local animal welfare groups to extend education and enforcement capacity.

Ensure local and central government are well placed to meet their responsibilities for animal welfare in emergencies (adverse events and natural disasters).

Resourcing

Ensure additional resources and support are available to improve animal welfare outcomes, including in relation to:

- establishing a dedicated Animal Health and Welfare unit within MPI;
- ensuring clear accountability for the Animal Welfare System within the MPI Senior Leadership Team;
- the development and implementation of requirements and regulations;
- monitoring and verification activities;
- education and promotion of voluntary compliance;
- animal welfare emergency response; and
- increased recognition of high performance and good practice in animal welfare.

Appendix C: Chronology of Events

NZ Bulldog Breed Standard Process: Chronology of Events

- **March 2017:** The Bulldog Clubs Propose a taskforce of clubs to work under the umbrella of NZKC.
- **ACOD 2017:** The Clubs Proposal is rejected and the Bulldog Clubs are told to move forward with their terms of reference which includes review of Breed Standards and development of education material to support breeders.
- **August 2017:** NZKC President meets with SBC. Bulldog Clubs should move forward with their taskforce work and that the best way to progress things re the Bulldog Standard is to work with the Bulldog Clubs not against them.
- **July 2018:** DogsNZ representative says the Bulldog Breed Standard will change during NZVA Seminar presentation.
- **August 2018:** DogsNZ invite the Bulldog Clubs to submit on recommendations to change the Bulldog Breed Standard.
- **October 2018:** DogsNZ receives submissions from Bulldog Clubs and members opposing any change to the Bulldog Breed Standard.
- **December 2018:** DogsNZ Executive Council decides based on recommendations by the Breed Standards Committee not to change the Bulldog Breed Standard.
- **March 2019:** Canine Health & Welfare Committee reconsider decision by Executive Council. Recommendation accepted by Executive Council.
- **13 May 2019:** DogsNZ tells Bulldog Clubs they will be changing the Bulldog Breed Standard from 1 August 2019. Will consult on which option – UK or FCI to change to.
- **17 May 2019:** Bulldog Clubs start their consultation and engagement and send notification and Bulldog Club letter to members and start social media campaign including asking for DogsNZ evidence.
- **23 May 2019:** Bulldog Club representative attends NAWAC meeting where DogsNZ representative states Bulldog Breed Standard will change.
- **24 May 2019:** The Bulldog Clubs release a petition in opposition to change and the DogsNZ process. Significant support shown.
- **27 May 2019:** DogsNZ release a survey to all registered members asking them all to vote on the their two options for changing the Bulldog Breed Standard.
- **28 May 2019:** DogsNZ withdraw survey after outcry.
- **29 May 2019:** Bulldog Clubs send further consultation information and template submission form to Bulldog Club members. Release template on public page for access by all non Bulldog Club Bulldog Breeders and owners. Template submission provides for all three options including No change.
- **1 June 2019:** DogsNZ releases a survey to bulldog breeders and owners with their two options for change. NO option to keep the standard.
- **3 June 2019:** Bulldog Clubs petition has 1750 signatures including significant bulldog breeder and owner support.