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# Best in show but not best shape: a photographic

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## assessment of show dog body condition

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**Running header**

Body condition of show dogs

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## Abstract

20 Previous studies suggest that owners often wrongly perceive overweight dogs to be  
21 in normal condition. The body shape of dogs attending shows might influence  
22 owners' perceptions, with online images of overweight show winners having a  
23 negative effect. This was an observational *in silico* study of canine body condition.  
24 14 obese-prone breeds and 14 matched non-obese-probe breeds were first  
25 selected, and one operator then used an online search engine to identify 40 images,  
26 per breed, of dogs that had appeared at a major national UK show (Crufts®). After  
27 images were anonymised and coded, a second observer subjectively assessed body  
28 condition, in a single sitting, using a previously validated method. Of 1120  
29 photographs initially identified, 960 were suitable for assessing body condition, with  
30 all unsuitable images being from longhaired breeds. None of the dogs (0%) were  
31 underweight, 708 (74%) were in ideal condition, and 252 (26%) were overweight.  
32 Pugs, Basset Hounds, and Labrador Retrievers were most likely to be overweight,  
33 whilst Standard Poodles, Rhodesian Ridgebacks, Hungarian Vizslas, and  
34 Dobermanns were least likely to be overweight. Given the proportion of show dogs  
35 from some breeds that are overweight, breed standards should be redefined to be  
36 consistent with a dog in optimal body condition.

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38 **Keywords.** Obesity, overweight, canine, pedigree dog, body composition

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## Introduction

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41

42 Canine obesity is now a common medical disorder (German 2006) with recent UK  
43 studies suggesting that over half of all pet dogs are now overweight (Courcier and  
44 others 2010). The condition is linked to diseases such as orthopaedic disease,  
45 diabetes mellitus, respiratory disease, and certain types of neoplasia (Lund and  
46 others 2006; German and others 2010), as well as being a major welfare concern  
47 given adverse effects on quality of life (German and others 2012) and longevity  
48 (Kealy and others 2002). Despite this, veterinarians uncommonly raise the issue of  
49 obesity with their clients (German and Morgan 2008; Rolph and Others 2014) and,  
50 when they do, it is often met with distrust (White and others 2010). This owner  
51 reaction might be due to the fact that owners under-estimate the true body condition  
52 of their dog, thereby believing overweight dogs to be slimmer than they are (Courcier  
53 and others 2010; Eastland-Jones and others 2014). The basis of owner  
54 misperception of body condition is not known, and two possibilities exist. First, it  
55 might be that their perception of body shape is incorrect, as with obese humans who  
56 under-estimate their own body size (Wright and Whitehead 1987) and parents who  
57 misperceive the body shape of their children (Campbell and others 2006).  
58 Alternatively, owners' perception of body shape might reflect that of society as a  
59 whole, with the condition of overweight dogs assumed to be normal. If the latter,  
60 were true, then images of dogs in the media might influence owners' perception of  
61 optimal body shape.

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63 Dog shows are the most popular form of canine competition, and receive widespread  
64 media interest. For instance, Crufts® is the UK's national dog show and is the

65 largest in the world, with 28,000 dogs participating each year, and 160,000  
66 spectators (Crufts<sup>®</sup> 2014a). Show dogs are perceived to be the ideal specimens of  
67 their breed, and images of dog show winners can be disseminated widely in the  
68 media, especially over the Internet. Given that 75-80% of UK dogs are purebred  
69 (O'Neill and others 2014), any deviation of the body condition of a show dogs from  
70 ideal, has the potential to adversely influence the perception of many dog owners as  
71 to what is normal. However, limited data currently exist on the body condition of  
72 show dogs as portrayed in online images. Given the null hypothesis that all show  
73 dogs would be in optimal condition, the main aim of the current study was to assess  
74 the body condition of show dogs using images available online. Assuming that the  
75 null hypothesis was rejected, a secondary aim was to determine factors associated  
76 with overweight body condition.

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## Materials and methods

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### Study protocol and overview

This was a cross-sectional, retrospective, *in silico*, study, conducted between February and May 2014 at the University of Liverpool School of Veterinary Science, and designed to assess the body condition of UK show dogs using online images. The study comprised 3 parts, discussed in further detail below. The first part consisted of image and data acquisition, and was conducted by one investigator (ZS). In the second part, another investigator (AJG), who was blinded to the dog details, subjectively assessed the body condition of dogs pictured in all of the images. Once the second part had been completed, the body condition results were matched to the dog-specific information to enable the second investigator to analyse the data (part 3).

### Part one: image and data acquisition

#### *Information Sources*

Photographs from dogs that have appeared at a UK national dog show (Crufts<sup>®</sup>) were identified using the online search engine (Google Images 2014). Searches were conducted on a single computer, between 20 February 2014 and 10 March 2014. First, available results from the Crufts<sup>®</sup> dog show (Crufts<sup>®</sup> 2014b) were examined to identify names of dogs that had been placed at shows. Each name was used as a search term to identify pictures of that dog. If the results returned were not specific enough to identify suitable images, the search was refined, for instance by adding the name of the relevant breed.

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104 *Breed Selection*

105 In order to ensure that a wide range of breeds was studied, a systematic searching  
106 protocol was used. First, a list of dog breeds prone to obesity was compiled, based  
107 upon previously published studies (German 2006; Lund and others 2006; Courcier  
108 and others 2010; Zoran 2010). Ultimately, 14 obese-prone breeds were identified,  
109 including breeds from all Kennel Club groups (The Kennel Club, 2014a) including  
110 Gundog (Labrador Retriever, Cocker Spaniel, Golden Retriever), Hound (Basset  
111 Hound, Beagle, Dachshund), Pastoral (Shetland Sheepdog), Terrier (Cairn Terrier,  
112 Scottish Terrier), Toy (Cavalier King Charles Spaniel, Pug), Utility (Dalmatian), and  
113 Working (Boxer, Rottweiler) groups. Each breed was paired with a breed from the  
114 same Kennel Club group that not reportedly prone to obesity. When possible,  
115 breeds were chosen that were similar to the obese-prone breed in terms of stature  
116 and body shape. The 14 non-obese prone breeds chosen comprised the following  
117 (listed in order of pairings with the obese-prone breeds above): Gundog group  
118 (Hungarian Vizsla, Springer Spaniel, Flat Coated Retriever), Hound group  
119 (Rhodesian Ridgeback, Basset Griffon Vendeen [Petit], Irish Wolfhound), Pastoral  
120 group (Welsh Corgi [Pembroke]), Terrier group (Border Terrier, West Highland White  
121 Terrier), Cairn Terrier, Scottish Terrier), Toy group (Chihuahua, Bichon Frise), Utility  
122 group (Poodle [Standard]), and Working group (Bullmastiff, Dobermann).

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125 *Eligibility of Dogs*

126 In order for a dog to be eligible it must have placed between first and fifth in its class  
127 (e.g. Open, Limit, Mid Limit, Post Graduate, Graduate, Under Graduate or Veteran)

128 at a UK national dog show (Crufts®) between 2001 and 2013. Additionally, only  
129 adults were considered because the photographic condition scoring system used  
130 had not been validated for growing dogs.

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### 132 *Eligibility of Images*

133 Images were only suitable if they were in focus, and had been taken from the side  
134 with the dog in a standing position (Laflamme 1997, German and others 2006).  
135 Furthermore, only one dog could be included in the picture in order to avoid  
136 confusion and possible bias through comparison between dogs. Finally, images were  
137 only used when the identity of the dog could be conclusively confirmed, based upon  
138 the details provided on the website where the image appeared.

139

### 140 *Image acquisition and data recording*

141 In order to ensure a range of images was assessed, a systematic approach was  
142 used for image acquisition. In this respect, suitable images of 5 male and 5 female  
143 dogs from each breed were selected, from each of 4 time categories (e.g. 2001-  
144 2008, 2009-2011, 2012, and 2013), making a total of 40 images per breed, and 1120  
145 images in total. Each image was assigned a unique study code, and temporarily  
146 saved to an external hard drive (1 TB Seagate® Expansion™ External Drive,  
147 Seagate) in Joint Photographic Experts Group (JPEG) format. A computer  
148 spreadsheet (Excel 2007, Microsoft Corporation) was created to record  
149 accompanying data for each image, as follows: study code, year of competition,  
150 breed, Kennel Club group, whether or not from an obese-prone breed, sex, coat  
151 colour, and placing in the show. No dog- or owner-identifying information was  
152 recorded.

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154 **Part 2: Subjective assessment of body condition**

155 Body condition was subjectively assessed from the images collected, in a single  
156 sitting, by a second investigator (AJG) with experience in assessing body condition  
157 from photographs. The technique used was a validated semi-quantitative scoring  
158 method using the visual descriptors used in conventional BCS systems (Laflamme  
159 1997, German and others 2006), with dogs being assigned to one of three  
160 categories: underweight (BCS 1-3/9), ideal condition (BCS 4-5/9), and overweight (6-  
161 9/9). In previous validation work (Gant and others 2013), the same investigator  
162 (AJG) assessed body condition using photographs from 105 dogs, and results  
163 correlated strongly with body fat mass measured by dual-energy X-ray  
164 absorptiometry ( $R_s$  0.84,  $P < 0.001$ ). The same approach was adopted in the current  
165 study, and all results were entered into a second computer spreadsheet (Excel  
166 2007), identified by the unique study code only. Once all images had been  
167 assessed, the hard drive was wiped so that there was no possibility of using the  
168 images for any other purposes, or of subsequently identifying the dogs that had  
169 participated in the study.

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171 **Part 3: Data analysis**

172 After part 2 of the project was completed, the data from both spreadsheets were then  
173 combined so as to match body condition results to the dog-specific information. A  
174 sample size calculation was not performed; instead, the number of images selected  
175 for each breed was arbitrarily determined so that the overall study size, was broadly  
176 similar to that of a previous study assessing body condition in dogs at shows  
177 (Corbee 2013).



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179 For each body condition category, results are reported as absolute numbers of dogs  
180 and percentages. Computer software (Stats Direct version 2.6.2; Stats Direct Ltd.)  
181 was used for all statistical analyses, with the level of significance set at  $P < 0.05$  for  
182 two-sided analyses. Logistic regression was used to determine what variables were  
183 associated with overweight body condition. The outcome variable tested was body  
184 condition, whereby dogs scored as overweight were assigned a score of 1, and dogs  
185 in ideal weight assigned a score of 0. Variables tested included sex, breed, Kennel  
186 Club group, breed prone to obesity, coat colour, year of competition, and placing in  
187 the show. Sex was classified according to a binary variable, with male dogs scored  
188 as 1, and female dogs scored as 0 (i.e. the reference category). For each breed, a  
189 dummy variable was created, whereby dogs of that breed were scored as 1 and  
190 dogs not of the breed scored as 0. For breed group, dummy variables were created  
191 for all Kennel Club groups (i.e. Gundog, Hound, Pastoral, Terrier, Toy, Utility, and  
192 Working), and Gundog was arbitrarily chosen as the reference category. In a similar  
193 manner, dummy variables were created for coat colour (i.e. light colour [e.g. cream,  
194 fawn, grey, white, and yellow], mid-colour [e.g. grizzle, red, russet gold, and  
195 wheaten], mixed colour [where. a mix of light and dark colours was present e.g.  
196 grizzle and white, liver and white, orange and white, tan and white, tricolour,], and  
197 dark colour [e.g. blue, black, chocolate, black and tan etc]), with light colour  
198 arbitrarily chosen as the reference category. For year of competition, dummy  
199 variables were created for each time category (e.g. 2001-2008, 2009-2011, 2012,  
200 2013), with 2001-2008 arbitrarily chosen as the reference category. Finally, dummy  
201 variables were created placing in each show (from 1<sup>st</sup> to 5<sup>th</sup>), with first place  
202 arbitrarily chosen as the reference category.

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204 Initially, all variables listed above were tested separately with simple logistic  
205 regression. Multiple regression was then use to account for possible confounding  
206 amongst variables, with an initial model including all variables identified as  $P < 0.2$  on  
207 simple regression analysis. This model was then refined over multiple rounds using  
208 backwards-stepwise elimination, of the least significant variable at each round, and  
209 variables were only retained in the final model if they were significant in their own  
210 right ( $P < 0.05$ ), or when removal led to a significant effect (i.e.  $> 10\%$ ) on the model.  
211 Goodness of fit of the final model was assessed by the Pearson Chi-square  
212 goodness of fit test. Logistic regression results are reported as odds ratios (OR),  
213 95% confidence intervals (95%-CI), and the associated P-value.

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### 215 **Ethical and copyright considerations**

216 Given the study design, there were both ethical and copyright considerations.  
217 Before the study commenced, the protocol was reviewed and approved by the  
218 University of Liverpool Research Ethics Committee (VREC185). As described  
219 above, a number of procedures were implemented to ensure anonymity for all dogs  
220 and owners. First, all images were anonymised (using a unique study code) before  
221 being used, and no dog- or owner-identifying information was recorded at any stage.  
222 Further, only one investigator performed the internet searches on a single computer  
223 and, as soon as all images had been acquired, the computer's internet search  
224 history was deleted. Moreover, only one copy of each image was saved to the  
225 external hard drive, and this was identified by a study code only. Finally, the  
226 investigator who assessed body condition, was unaware of any of the dogs' details,  
227 and the hard drive was wiped as soon as all images had been assessed.

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229 Given that the images used were acquired from the internet, it was critical to comply  
230 with appropriate copyright laws (Intellectual Property Office 2014). In this respect,  
231 “non-commercial research” is a permissible act under copyright law, and permission  
232 is not required to copy or use images in these circumstances. The images were not  
233 used for any other purpose and were not stored for any longer than was necessary  
234 for the study. As a result of this, owners of websites were not contacted in advance  
235 to request permission to use images.

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## Results

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### 238 **Images and dogs**

239 Of the 1120 individual images originally acquired, 960 proved to be suitable for  
240 assessing body condition. The 160 images that were unsuitable were all from breeds  
241 with long coats, including Bichon Frise, Scottish Terrier, West Highland White Terrier  
242 and Shetland Sheepdog breeds. In all cases, the long hair made it difficult to assess  
243 visual characteristics of condition reliably, such as abdominal tuck and whether ribs  
244 could be seen. Of the 960 dogs ultimately included, 0 (0%) were scored as  
245 underweight, 708 (74%) scored as ideal condition (n=708), and 252 (26%) as  
246 overweight. The number and percentages of dogs in the different body condition  
247 categories, stratified according to breed and other variables, are reported in Tables 1  
248 and 2, respectively.

249

### 250 **Simple logistic regression**

#### 251 *Breed*

252 On simple regression analysis (Table 1), overweight status was positively associated  
253 with three breeds (Basset Hound, OR=6.42, 3.25-12.64, P<0.001; Labrador  
254 Retriever, OR=5.09, 2.64-9.82, P<0.001; Pug, OR=12.73, 5.78-28.03, P<0.001) and  
255 negatively associated with six breeds (Border Terrier, OR=6.42, 3.25-12.64,  
256 P<0.001; Boxer, OR=6.42, 3.25-12.64, P<0.001; Dobermann, OR=6.42, 3.25-12.64,  
257 P<0.001; Hungarian Vizsla OR=6.42, 3.25-12.64, P<0.001; Standard Poodle,  
258 OR=6.42, 3.25-12.64, P<0.001; and Rhodesian Ridgeback, OR=6.42, 3.25-12.64,  
259 P<0.001). Although springer spaniel (OR=0.48, 0.20-1.17, P=0.11) was not  
260 significantly associated with overweight condition, this breed qualified for inclusion in  
261 the initial multiple logistic regression model.

262

263 *Other variables*

264 With simple logistic regression, overweight condition was positively associated with  
265 dogs from the toy group (OR 1.92, 1.21-3.05, P=0.01), and negatively associated  
266 with dogs in the utility group (OR 0.30, 0.14-0.66, P=0.003). Further, dogs with a  
267 light coat colour were more likely to be overweight than all other coat colours (vs.  
268 light colour: mid coat colour, OR=0.25, 0.15-0.40, P<0.001; mid coat colour,  
269 OR=0.58, 0.40-0.83, P=0.004; dark coat colour, OR=0.59, 0.40-0.89, P=0.01; Table  
270 2). However, there was no association between overweight status and either sex,  
271 placing in show, or time category, and no other variables qualified for inclusion in the  
272 initial multiple logistic regression model (Table 2).

273

274 **Multiple conditional logistic regression**

275 The initial multiple regression model comprised 13 variables: the dummy variables  
276 for 10 of the breeds (see above), and the three coat colour dummy variables (mid  
277 colour, mixed colour, and dark colour). The independent variables that remained in  
278 the final regression model were 9 of the breed dummy variables, and one coat colour  
279 variable, and this model was judged to be a good fit for the data (Table 3, P=0.66).  
280 Overweight status was positively associated with dogs that were Basset Hounds  
281 (OR=7.55, 3.63-15.67, P<0.001), Labrador Retrievers (OR=4.16, 2.11-8.21,  
282 P<0.001), or Pugs (OR=10.00, 4.46-22.41, P<0.001), and negatively associated with  
283 dogs that were Border terriers (OR=0.20, 0.06-0.67, P=0.01), Boxers (OR=0.27,  
284 0.08-0.91, P=0.03), Dobermanns (OR=0.13, 0.03-0.56, P=0.01), Hungarian Vizslas  
285 (OR=0.13, 0.03-0.56, P=0.01), Rhodesian Ridgebacks (OR=0.13, 0.03-0.56,

286 P=0.01), Standard Poodles (OR=0.06, 0.01-0.47, P=0.01), or had a mixed coat colour  
287 (OR=0.69, 0.047-1.00, P=0.05).

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## Discussion

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In the current study, we have assessed the body condition of show dogs using online images. Approximately 26% of the show dogs examined were overweight, which is less than recent reported prevalence of overweight dogs in the UK pet dog population (Courcier and others 2011). However, the findings are similar to results from a previous study that assessed the body condition of show dogs in the Netherlands, where 19% of dogs were overweight (Corbee 2013). Whilst this suggests that show dogs may be in better body condition than the pet population as a whole, the fact that approximately a quarter were above ideal weight is still a cause for concern. These dogs showcase the ideal characteristics of the pedigree breed, and there is a danger that widespread media exposure might adversely influence owner perception of optimal body shape. Whilst the three breeds with the greatest prevalence of overweight condition were from the obese-prone category, the prevalence of overweight condition was low in boxers, despite the fact that this breed was also in the obese-prone category. This suggests that not all obese-prone dogs are overweight at national shows. In light of this, breed-specific approaches might be most pertinent for addressing the issue for show dogs.

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In a previous study regarding body condition of show dogs, prevalence of overweight status was greater in some breeds (Corbee 2013). Similar findings were noted in the current study, with overweight condition being highly prevalent in three breeds, but uncommon in six others. However, in the previous study, whilst many different breeds were included, only small numbers of dogs were assessed for many of the individual breeds, limiting the ability to judge prevalence within breed. Further, the

314 author assessed body condition only once, making it impossible to assess possible  
315 changes in prevalence over time, and also did not consider a possible influence of  
316 other factors such as placing within the show. Whilst the study was of a similar  
317 magnitude, the use of Internet images in the current study enabled us to adopt a  
318 systematic approach to case inclusion. Further, we increased the numbers of dogs  
319 examined per breed by only assessing breeds prone to obesity, and matched control  
320 breeds. Despite the systematic breed selection, the diversity of breeds selected was  
321 wide, comprising a range of statures (from Miniature Dachshund to Irish Wolfhound),  
322 breeds from all Kennel Club groups, and 10 of the 20 most popular UK Kennel Club  
323 breeds by registration in 2013 (The Kennel Club 2014b). Further, by systematically  
324 including images from a 13-year period, and recording data on placing in show, we  
325 were able to whether any temporal changes in body condition had occurred in show  
326 dogs, and to what extent body condition influenced placing in the show.

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328 In light of adverse media publicity, much greater emphasis has recently been placed  
329 on promoting good health in pedigree dogs, and discouraging exaggeration of  
330 characteristics that may cause adverse health effects (Crispin 2011). There have  
331 also been changes in policy regarding the criteria for judging dogs at shows, with the  
332 aim of encouraging more responsible breeding and pet ownership. Indeed, in 2014,  
333 the UK Kennel Club introduced its 'Breed Watch' scheme, designed to act as an  
334 early warning system to increase awareness of possible health problems in specific  
335 breeds (The Kennel Club 2014c). Further, judges are advised to ensure that only  
336 dogs perceived to be healthy dogs win prizes, and are given breed-specific advice  
337 on what characteristics that can produce adverse health effects. Indeed, overweight  
338 body condition is included as a point of concern for many breeds. Disappointingly, in



339 the current study, we did not identify any difference in the prevalence of overweight  
340 condition based upon placing in the show, suggesting that being overweight does not  
341 reduce the likelihood of a dog winning. Further, there was no apparent evidence of a  
342 change in prevalence of overweight condition during the 13-year course of the study.  
343 This finding should be placed in the context of a rising overall prevalence of canine  
344 obesity in the UK pet population during this time (Edney and Smith 1986, Courcier  
345 and others 2010). Although this relative decrease in prevalence might be  
346 encouraging, it is disappointing that a quarter of show dogs remain overweight.  
347 Nonetheless, the findings regarding show placing and change in prevalence over  
348 time, cannot be taken as evidence that recent changes to guidance of show dog  
349 judges have not worked, because schemes such as the Kennel Club's Breed Watch,  
350 was introduced in 2014 (The Kennel Club 2014c), after the period used for the  
351 current study.

352

353 The Pug was originally bred to be a companion dog (The Kennel Club 2014a) and,  
354 as a consequence, no physiological advantage would be expected from an  
355 overweight body condition. Although the current standard is for a 'square and cobby'  
356 shape, the recommendation is that this be the result of muscle mass rather than fat  
357 (The Kennel Club 2014a). The results of the current study indicated that 80% of  
358 Pugs from shows were overweight, which is similar to the 71% overweight  
359 prevalence reported in Pugs from a population of pet dogs (Mao and others 2013),  
360 and consistent with body condition scores reported in a recent investigation at a dog  
361 show (Corbee 2013). The Pug is a high profile breed for health problems (The  
362 Kennel Club 2014c), and the high prevalence of overweight dogs highlights the need  
363 for urgent action to address this within the breed. Not surprisingly, therefore, the UK

364 Kennel Club has placed the Pug in category 3 (points of concern for health) in the  
365 'Breed Watch' health-monitoring programme, and "significantly overweight is a point  
366 of concern for special attention by show judges.

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368 Overweight condition was also prominent in Basset Hounds and Labrador retrievers  
369 where 68% and 63%, respectively, of show dogs were overweight. Since Bassett  
370 Hounds were traditionally bred for endurance and hunting, and Labrador retrievers  
371 were bred for field work (The Kennel Club 2014a), any increase in body weight could  
372 be disadvantageous to function. The Kennel Club's breed standard for Bassett  
373 Hounds suggests that dogs of the breed should be of 'considerable substance', but  
374 no guidance is given on the desired body composition (The Kennel Club 2014a).  
375 Therefore, it is possible that breeders with Bassett Hounds of smaller stature might  
376 attempt to increase 'substance' by increasing body fat mass. For Labrador  
377 retrievers, the breed is expected to be agile, and without excess body fat. The chest  
378 is expected to be 'of good width and depth', and this might increase the potential for  
379 owners of show dogs to aim for a heavier set dog. Whilst, the standard states that  
380 the effect not be produced by carrying excess weight, the inability of dog owners to  
381 judge body condition accurately (The Kennel Club 2014a), may make it difficult to  
382 avoid. As with the Pug, the Bassett Hound is a high profile breed (The Kennel Club  
383 2014c), and judges are required to monitor overweight status amongst other issues.  
384 In contrast, Labrador retrievers are in the second most severe category of the  
385 national breed watch list, though show judges have been asked to be alert for  
386 significantly overweight examples (The Kennel Club 2014c).

387

388 In contrast to the fact that over a quarter of dogs were overweight, none were  
389 underweight, and perhaps suggests whilst that owners, breeders, and judges are  
390 more aware of the characteristics associated with underweight condition than of  
391 overweight condition. Indeed, whilst owners of underweight dogs do tend to over-  
392 estimate the condition of their dog, the effect is less marked than the tendency for  
393 owners of overweight dogs to under-estimate condition (Eastland-Jones and others  
394 2014). Clearly, therefore, more effort is required to educate owners, breeders, and  
395 show judges so that they can all better recognise overweight condition.

396

397 Simple regression analysis revealed that a light coat colour was associated with  
398 overweight condition but, as was the case for the obese-prone breed category, the  
399 effect was not significant in the final multiple regression. Thus, rather than coat  
400 colour affecting the perception of body shape, individual breed effects likely explain  
401 the effect. Indeed, many dogs from obese-prone breeds had a light coat colour, for  
402 example 50% of Labrador retrievers, and 95% of the pugs were fawn; further, many  
403 non-obese-prone breeds had other coat colours such as Hungarian Vizslas and  
404 Rhodesian Ridgebacks which were both in the mid-colour range.

405

406 As with any study, there are limitations that should be considered when interpreting  
407 the results. Most importantly, whilst photographic assessment of body condition  
408 correlates well with body fat mass measured by DEXA, it does not perform as well as  
409 conventional body condition score assessment (Gant and others 2013). Thus, there  
410 may have been errors in the assessments for some of the dogs. Most notable was  
411 the fact that it was not possible to assess the body condition of some longhaired  
412 breeds and, consequently, these were removed from the analysis. To minimise the

413 errors of the method, we ensured that a single observer, with experience in using a  
414 validated photographic body condition score method, assessed all dogs in a single  
415 sitting. Therefore, it would be advisable to conduct further studies, using different  
416 methods of assessing body condition, and including with more dogs.

417

418 A second limitation was that selection of obese-prone breeds was based upon a  
419 number of recent and historical studies, including those from other studies. The  
420 breeds identified in these studies might not have been representative of the UK dog  
421 population. Third, whilst every effort was made to match breeds not prone to obesity  
422 with the chosen obese-prone breeds, this was not always possible. Most  
423 challenging was finding matches within the hound group; for instance, Dachshund  
424 and Beagles were paired with Rhodesian Ridgeback and Irish Wolfhound,  
425 respectively, even though stature was not well matched. Such a matching was not  
426 perfect, but arose because it was not possible to identify breeds of an equivalent  
427 stature, with sufficient images available for review. Despite this limitation the  
428 diversity of breeds was wide, and it is unclear to what extent the results were  
429 affected. A fourth limitation was the fact that, given the systematic method of  
430 selection, not all breeds were examined. Therefore, whilst the issue of overweight  
431 condition has been highlighted in certain breeds, similar issues might have been  
432 missed for breeds with unexpected problems. Further investigations would help to  
433 confirm the current findings, by enabling more dogs in more breeds to be assessed.

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## Conclusion

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438 This study has shown that a significant proportion of show dogs from some breeds,  
439 such as Pugs, Basset Hounds and Labrador Retrievers are overweight. Although  
440 overweight condition in show dogs is less prevalent than in the general pet  
441 population, these findings are still concerning given the widespread potential for  
442 dissemination of images through the media. Further effort is now required to  
443 educate owners, breeders, and show judges so that they can all better recognise  
444 overweight condition, thus helping to prevent the development of obesity.  
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## **Author contributions**

The contribution made by each author is as follows: ZS – collated relevant clinical data, analysed results, reviewed manuscript. AJG – designed study, collected clinical data, analysed results, drafted paper. Both authors have approved the final article.

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