

1 **Overweight dogs are more likely to display undesirable behaviours: results of a large online**
2 **survey of dog owners in the United Kingdom**

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23
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33 **Abstract**

34

35 Much of the global canine population is now overweight, and this can adversely affect health,
36 lifespan, and quality of life. Undesirable behaviours are also common in pet dogs, and these can
37 adversely affect welfare, as well as being stressful to owners. However, links between obesity and
38 behavioural disorders have never previously been explored. An online survey was conducted
39 between June and August in 2014, coinciding with the broadcast of a National UK television
40 programme, exploring dog health, welfare and behaviour. Information gathered included
41 signalment, overweight status, and the prevalence of a range of undesirable behaviours. Fisher's
42 exact test and odds ratios were used to determine associations between overweight status and
43 owner-reported behaviours. A total of 17,028 responses were received. After data verification, the
44 final dataset comprised 11,154 dogs, 1,801 (16.1%) of which were reported by owners to be
45 overweight. Owners of overweight dogs were more likely to see them as "a baby" ($P<0.0001$) and
46 allow them to sleep on their bed ($P<0.0001$). Overweight dogs were also more likely to guard food
47 ($P<0.0001$), and steal food ($P<0.0001$). Other undesirable behaviours more commonly reported in
48 overweight dogs included barking, growling or snapping at strangers ($P=0.0011$) and other dogs
49 ($P=0.0015$), being fearful of outdoors ($P<0.0001$), and not always coming back when called
50 ($P=0.0011$). Finally, owners were more likely to report that unsociable behaviours adversely
51 affected their dog's health ($P<0.0001$). Overweight status is associated with a number of
52 undesirable behaviours in dogs. Further studies are now required to explore the reasons for these
53 associations.

54

55

56 **Introduction**

57

58 A multitude of problems can affect the welfare of dogs, ranging from inappropriate husbandry to
59 euthanasia of healthy dogs. In a recent study, seven experts were asked to rank welfare priorities in
60 dogs, and two of the top-rank priorities were undesirable behaviours and obesity.⁽¹⁾ Undesirable
61 behaviours are known to be common in pet dogs, with one study estimating 90% of the population
62 to be affected.⁽²⁾ Problems can include aggression to familiar people, strangers or other dogs;
63 fearfulness; separation anxiety; and food-related behaviours such as food guarding, food stealing,
64 and coprophagia.⁽³⁾ Obesity is also a considerable welfare concern in dogs; recent studies suggest
65 that approximately half of all pet dogs are overweight,^(4,5) and this can predispose dogs to many
66 diseases,^(4,7) poorer quality of life,⁽⁸⁾ and a shorter lifespan.⁽⁹⁾

67

68 Therefore, whilst obesity and undesirable behaviours both impact canine welfare, the degree to
69 which they may be related is not known. Therefore, the aim of the current study was to examine the
70 associations between overweight status and undesirable behaviours, based upon attitudes of owners
71 in a large, anonymous, online survey.

72

73

74 **Methods and Materials**

75

76 *Study design and methodology*

77 Over the summer of 2014, a television documentary series entitled "Dogs - Their Secret Lives"
78 aired on Channel 4 television. The 4-part series dealt with the health and wellbeing of dogs in the
79 UK, and aimed to inform the general public of issues of critical current importance. The series
80 featured three of the study authors (AJG, EB, ME). As part of the overall project, an online survey
81 into the health and welfare of dogs was conducted between June and August in 2014, coinciding
82 with the broadcast of a National UK television programme, exploring dog health, welfare and
83 behaviour. The study was approved by the University of Liverpool Ethics Committee.
84 Participation was voluntary, with owners wishing to participate logging onto the Channel 4 website
85 in order to complete the survey. Owners gave their permission for their data to be used, in a fully
86 anonymised form (i.e. no client-identifying data), and for the results to be publicised both on the
87 television shows and online. Further, they were not required to answer questions that they were
88 unclear about, or did not wish to answer. To be eligible for inclusion in the data analysis part of the
89 study, dogs had to be adult (≥ 2 years of age) and questionnaire information needed to be complete
90 **i.e. all questions used in the current study needed to be answered.**

91

92 *Survey design*

93 The online survey comprised 43 questions, 4 of which covered personal data and these were not
94 shared with the study investigators. Other questions covered details of signalment (age, sex, neuter
95 status, breed), body weight and overweight status (based upon the response to the survey question:
96 "Is your dog overweight?"), current body weight, lifestyle, questions on a range of undesirable
97 behaviours, and activity. Free text boxes were available for the questions on age and bodyweight;
98 the remaining questions were either binary in nature (yes-no) or categorical, and selections were
99 made either by checking a box or selecting responses from a drop-down menu. Owners could only
100 select one category. **For overweight status, owners responded to the question "Is your dog
101 overweight?", with their answer being based on their own subjective impression (i.e. no reference to
102 a formal body condition scoring system). The main questions considered in the current study were
103 those relating to undesirable behaviours, whereas the questions involving activity are reported in
104 two associated studies.^(10,11)**

105

106 *Data handling and statistical analysis*

107 All data were collated into a computer spreadsheet (Excel version 14, Microsoft, Redmond,
108 Washington, USA) for analysis. Initially, data cleaning was conducted to **ensure reliability of the**

109 data analysed. First, given that body weight was used to confirm overweight status (see below), it
110 was necessary to ensure that growing dogs were not included in the dataset. This was done by
111 removing data from all dogs under 2y age. The dataset was further cleaned by removing dogs with
112 any missing data, and dogs with obvious errors in the dataset for age and bodyweight. The latter
113 involved manually checking the spreadsheet for obvious data errors. First, the entire spreadsheet
114 was inspected for obvious erroneous values (e.g. age or bodyweight entered as 0 or an improbable
115 value (i.e. age >30 years, bodyweight >150 kg). Next, age data were sorted first by breed and then
116 by age using the "sort" function. For each breed, individual dog ages were checked and compared
117 with expected age range of the age of the breed based upon that reported within an online
118 encyclopaedia (<https://www.wikipedia.org>). Dogs with ages more than 20% outside the range
119 reported for each breed (given uncertainties of the reported age ranges) were removed. Finally,
120 bodyweight data were sorted first by breed, then by sex, and then overweight status. Dogs that were
121 reportedly not overweight but had a bodyweight more than 20% above the range reported for each
122 breed (given uncertainties in the reported bodyweight ranges) were removed.

123

124 Computer software (Stats Direct version 3.0.171; Stats Direct Ltd.) was used for all tests. Data are
125 expressed as median (range) unless otherwise stated. Odds ratios (OR) and 95% confidence
126 intervals (95%-CI) were calculated in order to determine the association between owner-reported
127 overweight status and various parameters, including sex, neuter status, and the responses to
128 unsociable behaviours. Exceptions were for comparisons of age and bodyweight, where the Mann-
129 Whitney test was used, and for the question "how do you see your dog?" which had multiple
130 categories and was assessed with the Fisher's exact test. First, the test was performed across all
131 categories simultaneously using the "r by c Fisher" function in Stats Direct. Subsequently, the
132 proportion of owners that selected the category "baby" was compared with the proportion of owners
133 selecting another answer using a 2x2 Fisher's exact test. Given that multiple comparisons were
134 performed, a modified Bonferroni correction was applied.⁽¹²⁾ This correction effectively meant that
135 statistical significance was only considered when $P < 0.0017$.

136

137 **Results**

138

139 ***Final dataset***

140 A total of 17,028 responses were received. After cleaning, the final dataset comprised 11,154 dogs,
141 6220 of which were male (4932 neutered [79.3%]) and the remaining 4934 were female (4280
142 neutered [86.8%]). Over 80 breeds were represented, with the most common being border collie
143 (583), Cavalier King Charles Spaniel (224), Cocker spaniel (512), mixed breed (2794), English
144 springer spaniel (473), German Shepherd Dog (336), Golden Retriever (276), Jack Russell Terrier
145 (606), Labrador Retriever (1344), Staffordshire Bull Terrier (451), and West Highland White
146 Terrier (217). Median age was 5 years (range 2-19 years) and median bodyweight was 20 kg (range
147 1-107 kg).

148

149 ***Owner-reported overweight status***

150 Of the 11,154 dogs, 1801 dogs were reported to be overweight (16.1%). To confirm that the
151 overweight population was representative, associations with various signalment variables were
152 assessed. Overweight dogs were significantly older (6 y [2-16 y] vs. 5y [2-19y], $P<0.001$) and
153 heavier (22 kg [1-107 kg] vs. 20 [1-107], $P<0.0001$) than dogs that were reported to be in ideal
154 weight. Overweight status was also positively associated with being neutered, but not with sex,
155 whilst a range of breeds were either positively (**Beagle, Cavalier King Charles Spaniel, Chihuahua,**
156 **Labrador retriever and Pug**) or negatively (German Shepherd Dog and Greyhound breeds)
157 associated (Table 1).

158

159 ***Associations between owner attitudes and overweight status***

160 When owners were asked how they viewed their dog, those that owned overweight dogs were more
161 likely to select "your baby" (507/2548 [20%] overweight; odds ratios [OR] 1.538, $P<0.0001$) than
162 to use one of the other descriptions (total 1294/8606 [15%] overweight: "your protection", 1/35
163 [3%]; "your assistant" 3/36 [8%]; "your companion", 570/3812 [15%]; "your best friend", 339/2089
164 [16%], or "your pet", 381/2634 [14%]). Owners of overweight dogs were also more likely to allow
165 them to sleep in or on their bed (OR 1.432; 95%-CI 1.293-1.539; $P<0.0001$), but not more likely to
166 keep a photograph of their pet with them (OR 1.034; 95%-CI 0.927-1.153; $P=0.5522$).

167

168 ***Associations between overweight status and undesirable behaviours***

169 Associations between overweight status and a range of undesirable behaviours were tested (Table
170 2). Dogs that were reported to be overweight were more likely to guard food ($P<0.0001$), steal food
171 ($P<0.0001$), not always come back when called ($P=0.0002$), be fearful or reluctant to walk outside

172 ($P<0.0001$), and be more likely bark/growl/snap at other dogs ($P=0.0015$) and strangers
173 ($P=0.0011$). **Dogs** that did not always come back when called were less likely to be let off the lead
174 than those that always returned (OR 0.425, 95%-CI 0.388-0.465; $P<0.0001$). Similar associations
175 were also seen between dogs barking, growling at both other dogs (OR 0.410, 95%-CI 0.374-0.449;
176 $P<0.0001$) and strangers (OR 0.650, 95%-CI 0.581-0.727; $P<0.0001$) and the likelihood of being let
177 off the lead. However, a direct association between overweight status and being let off the lead was
178 not identified (OR 0.908, 95%-CI 0.807-1.023; $P=0.1060$). Further, there was no association with a
179 range of other behaviours (Table 2).

180

181 ***Influence of undesirable behaviour and health***

182 More owners of overweight dogs reported that behavioural issues adversely affected health
183 (752/1801, 42%) than for owners who did not believe their dog to be overweight (3347/9353, 36%;
184 OR 1.286, 95%-CI 1.159-1.427; $P<0.0001$).

185

186 **Discussion**

187

188 This study describes the largest survey of owner attitudes to canine behaviour and welfare ever
189 conducted, and some intriguing associations were identified between obesity and undesirable
190 behaviour, including for the food-related behaviours (guarding and stealing food), displays of
191 aggression to strangers or other dogs, being fearful of walking, and not returning when called.
192 Furthermore, owners of overweight dogs were more likely to report that such undesirable
193 behaviours were more likely to affect health than did owners of dogs not reported to be overweight.
194 Given the fact that the study was cross-sectional in nature, the reasons for these associations cannot
195 be determined, including whether or not they are causal. Prospective studies should now be
196 considered to explore the nature of these associations more completely.

197

198 Assuming that the associations discovered are genuine, the link between overweight status and both
199 food-seeking and food-guarding behaviour is perhaps most logical. For example, there might be
200 common risk factors for both, for example that cause a stronger drive for food, making affected
201 dogs more likely both to display food-related behaviours and to overeat causing weight gain. Such
202 factors could be genetic and, in this regard, a deletion in the canine proopiomelanocortin gene was
203 discovered in some dogs of the Labrador Retriever breed, and this was found to be associated with
204 both appetite and weight status in affected dogs.⁽¹³⁾ Alternatively, the behaviour of the owner might
205 be important, whereby different styles of ownership might mean different feeding regimes, food
206 types and rewards, predisposing some dogs to weight gain and undesirable food-related behaviour.
207 Here, a parallel can be drawn with parenting and childhood obesity. In this respect, different
208 parenting styles have been identified which reflect differences in the degree of control the parent
209 places over their child's behaviour and the responsiveness of the parent to their child's wishes.⁽¹⁴⁾
210 The children of parents who display either an indulgent style (i.e. displaying warmth and respect for
211 their child's needs but only limited monitoring of their behaviour) or an authoritarian style (i.e.
212 making high demands on their children whilst showing little responsiveness to their opinions or
213 wishes) are more likely to be overweight than those who show other styles.^(14,15) There are many
214 parallels between how parents care for children and how owners care for their dogs, and a recent
215 review considered how pet ownership styles could be mapped to parenting styles⁽¹⁶⁾. If dog-
216 ownership styles exist that are similar to the indulgent and authoritarian parent styles, then similar
217 predispositions might exist for canine obesity. Whilst the current work did not examine this
218 directly, it was notable that owners who reported their dog to be overweight appeared to have a
219 different relationship with them, in that they were more likely to see them as a baby and more likely
220 to let them sleep in or on the bed. Further, other studies have demonstrated that owners of

221 overweight dogs feed them more snacks and table scraps, observe them more closely during feeding
222 and also more often allow the dog to be present when preparing a meal^(17,18) Additional studies
223 could examine attitudes and opinions of owners towards feeding their dogs, and explore the
224 similarity to parenting behaviour more fully.

225

226 Possible reasons for associations between being overweight and other undesirable behaviours are
227 less clear. It is possible that owners whose dogs demonstrate aggressive behaviours to strangers and
228 other dogs are less likely to exercise them outside or restrict their freedom if they do.⁽¹⁹⁾ Indeed, we
229 found that such dogs were less likely to be let off the lead than those not displaying such
230 behaviours. However, given that there was no direct association between dogs being let off the lead
231 and overweight status, other factors might also contribute. One alternative reason for the link
232 between undesirable behaviours and overweight status may be the incorrect practice of reward-
233 based behaviour therapy/dog training, in terms of excessive food rewards to reinforce positive
234 behaviour, thereby encouraging overeating. For this reason, owners should always be recommended
235 to adjust the dog's food intake appropriately and ideally use the pre-measured daily food ration for
236 training.

237

238 One final observation was the fact that owners of overweight dogs were more likely to state that
239 undesirable behaviours adversely affected their dog's health. The reason for this association is not
240 clear. It might be a direct association, for example the overweight status making the behaviour
241 more severe. Alternatively, the association might represent a cumulative effect on health. In this
242 respect, obesity is known to adversely affect quality of life in dogs,⁽⁸⁾ so it might appear that dogs
243 also displaying an undesirable behaviour are perceived to have a greater adverse effect on health
244 simply because the dog is starting from a lower baseline quality of life. Once again, further studies
245 are required both to confirm this association and to explore the reasons for it.

246

247 The study has a number of limitations that should be considered. Most notable was the fact that
248 only 16.1% of dogs were reported to be overweight by their owner, which is considerably less than
249 current estimates of overweight and obesity in UK dogs.⁽⁵⁾ The reason for this is not clear. One
250 explanation might be participation bias, whereby the owners who were willing to participate were
251 not representative of the UK dog owning population. For example, dog owners could have been
252 reluctant to participate if they knew their dog was overweight or were concerned. A second
253 possible explanation for the low prevalence of overweight dogs might be misinterpretation of body
254 shape by owners, since recent studies have demonstrated that owners under-estimate the true body
255 condition of their dog, often not realising they are overweight⁽²⁰⁾. **This is a concern for the current**

256 study because owners were not given any criteria to use for deciding whether their dog was
257 overweight. The upshot of this would be many overweight dogs being inappropriately classified as
258 not overweight, and this would tend to obscure differences between groups. Therefore, the true
259 effect size of the associations between overweight status and undesirable behaviours might actually
260 be stronger than was seen in the current study. Ideally, therefore, the current findings should now
261 be confirmed with studies using different methods of assessing overweight status, for example the
262 use of body condition scoring conducted by a trained veterinary professional.

263

264 A second limitation was the fact that the use of an online format meant that response options were
265 limited with owners having to choose from categories or binary options (i.e. yes or no). Therefore,
266 there was no opportunity to explore the observations in any more detail, and the fact that the survey
267 was fully anonymised means that further information cannot be obtained from the owners who
268 participated. Thirdly, given that the survey was conducted in association with a TV documentary
269 series examining behaviour and obesity in dogs, results might have been influenced by response
270 bias, with the effect that owners consciously or subconsciously adapted their responses having
271 watched the programmes.

272

273 Finally, this study is limited by the fact that it is exploratory in nature, and only examined simple
274 associations without adjustment for confounding. This was not undertaken because of the multiple
275 comparisons that had already been performed. It is likely that behavioural variables may correlate
276 with confounders such as reduced exercise, or breed, which also lead to overweight. Future studies
277 purposefully designed to examine independent associations should use multivariable analyses to
278 adjust for confounding variables.

279

280

281 **Conclusions**

282 In the current study, overweight status in dogs (as reported by their owners) was associated with a
283 number of undesirable behaviours including food stealing, food guarding and aggression both to
284 other dogs and strangers. Further studies are now required to explore the reasons for these
285 associations.

286

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290

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295

296 **Conflict of Interest**

297 Royal Canin financially supports the post of AJG at the University of Liverpool, whilst Dogs Trust
298 Financially supports the post of EB at the University of Bristol.

299

300 **Authorship**

301 AJG, EB, and ME proposed the research questions and designed the survey. AJG conducted the
302 statistical analyses and CW advised. AJG, EB and CW interpreted the results. AJG produced the
303 first draft of the manuscript, which was subsequently reviewed and edited by the other authors. All
304 authors approved the final manuscript.

305

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353

354 **Table 1. Odds ratios and 95% confidence intervals for signalment factors associated with**
 355 **overweight status**

Variable	OW	Not OW	Odds Ratio	95% CI	Probability
Age (per year)	---	---	1.076	1.061-1.092	<0.0001
Sex					
Female (reference)	1583	8165	1.000	---	---
Male	218	1188	0.946	0.807-1.06	0.509
Neuter status					
Entire (reference)	177	1765	1.000	---	---
Neutered	1624	7588	2.134	1.810-2.19	<0.0001
Body weight (per kg)	---	---	1.018	1.014-1.022	<0.0001
Breed					
Basset	12	36	1.734	0.901-3.343	0.099
Beagle	57	52	5.846	4.000-8.543	<0.0001
Bichon Frise	14	60	1.213	0.677-2.176	0.516
Border Collie	74	509	0.744	0.580-0.955	0.020
Border Terrier	37	162	1.190	0.830-1.707	0.345
Boxer	22	141	0.808	0.514-1.270	0.355
Bull terrier	12	36	1.734	0.901-3.343	0.099
Bulldog	14	30	2.435	1.288-4.600	0.0061
Cairn terrier	14	41	1.779	0.968-3.271	0.064
Cavalier King Charles Spaniel	67	157	2.263	1.692-3.026	<0.0001
Chihuahua	29	63	2.413	1.550-3.757	<0.0001
Cocker Spaniel	102	410	1.310	1.048-1.637	0.018
Dachshund	20	75	1.389	0.846-2.281	0.194
Dalmatian	5	66	0.392	0.158-0.974	0.044
Doberman	9	51	0.916	0.450-1.884	0.809
English Springer Spaniel	63	410	0.791	0.603-1.036	0.088
Flat-coated retriever	3	46	0.338	0.105-1.087	0.069
German Shepherd Dog	31	305	0.520	0.358-0.754	0.0006
Golden Retriever	62	214	1.522	1.142-2.029	0.0041
Greyhound	9	182	0.253	0.129-0.495	<0.0001
Hungarian Vizla	4	51	0.406	0.146-1.125	0.083
Irish Setter	2	38	0.272	0.066-1.131	0.073
Jack Russell Terrier	99	507	1.015	0.813-1.266	0.896
Labrador Retriever	285	1059	1.472	1.278-1.697	<0.0001
Lhasa Apso	17	53	1.672	0.966-2.894	0.066
Miniature Schnauzer	25	95	1.372	0.880-2.137	0.162
Poodle	3	76	0.204	0.064-0.646	0.0069
Pug	17	22	4.042	2.142-7.626	<0.0001
Rhodesian Ridgeback	7	37	0.982	0.437-2.207	0.966
Rottweiler	18	86	1.088	0.653-1.812	0.746
Rough-Coated Collie	11	53	1.078	0.562-2.068	0.820
Shih Tzu	19	83	1.191	0.721-1.965	0.494
Siberian Husky	7	61	0.594	0.271-1.301	0.193
Staffordshire Bull Terrier	85	366	1.212	0.955-1.549	0.112
Weimaraner	5	47	0.551	0.219-1.388	0.206
West Highland White Terrier	41	176	1.215	0.861-1.713	0.267
Whippet	5	68	0.380	0.153-0.944	0.037
Yorkshire Terrier	19	96	1.028	0.627-1.687	0.912

356 CI, confidence interval. Modified Bonferroni correction applied, so statistical significance
357 considered when $P < 0.0017$. Results reaching statistical significance are highlighted in bold.
358

359 **Table 2. Odds ratios and 95% confidence intervals for behaviours associated with overweight status**

Which of the following behaviours does your dog display on a regular basis?	Yes¹	No¹	Odds Ratio	95% CI	Probability
Eat faeces	364/1993 (18.3%)	1437/9161 (15.7%)	1.201	1.055-1.365	0.0053
Guard food items / possessions	261/1151 (22.7%)	1540/10003 (15.4%)	1.612	1.384-1.872	<0.0001
Steal food or scavenge items	617/2765 (22.3%)	1184/8389 (14.1%)	1.748	1.565-1.951	<0.0001
Bark, howl, destroy, toilet or chew things at home	174/1148 (15.2%)	1627/10006 (16.3%)	0.920	0.772-1.092	0.3517
Toilet indoors when home alone	62/334 (17.6%)	1739/10820 (16.1%)	1.190	0.884-1.582	0.2270
Bark/whine when not home alone	305/1733 (17.6%)	1496/9421 (15.9%)	1.131	0.985-1.297	0.0758
Avoid/run away from:					
other people	148/874 (16.9%)	1653/10280 (16.1%)	1.064	0.879-1.282	0.5029
other dogs	233/1378 (16.9%)	1568/9776 (16.0%)	1.065	0.912-1.240	0.4117
Not always come back when called	842/4771 (17.6%)	959/6383 (15.0%)	1.212	1.093-1.343	0.0002
Pull on lead	869/5534 (15.4%)	932/5520 (16.9%)	0.898	0.810-0.994	0.0371
Jump up or try to get attention from people	798/5086 (15.7%)	1003/6068 (16.5%)	0.940	0.848-1.041	0.2348

Bark growl snap at:

other dogs	629/3535 (17.8%)	1172/7619 (15.4%)	1.191	1.069-1.326	0.0015
strangers	346/1847 (18.7%)	1455/9307 (15.6%)	1.244	1.089-1.418	0.0011
familiar people	114/536 (21.3%)	1687/10618 (15.9%)	1.344	1.076-1.668	0.0078
Chase:					
traffic	91/523 (17.4%)	1710/10631 (16.1%)	1.099	0.862-1.389	0.4288
other things like cyclists, joggers	188/1057 (17.8%)	1613/10097 (16.0%)	1.138	0.958-1.346	0.1352
Fearful of noises - run away, hide, whimper	188/1057 (17.8%)	1613/10097 (16.0%)	1.018	0.896-1.156	0.7726
Fearful of outside - reluctant to walk	65/254 (25.6%)	1736/9484 (15.9%)	1.815	1.341-2.431	<0.0001
Obsessively lick himself/herself or people	304/1670 (18.2%)	1497/9484 (15.8%)	1.187	1.0328-1.362	0.0142
Spin or chase his/her tail	109/857 (12.7%)	1692/10297 (16.4%)	0.741	0.596-0.914	0.0043
Have the selected behaviours affected your dog's health or happiness?	752/4099 (18.3%)	1049/7055 (14.9%)	1.286	1.159-1.427	<0.0001

360 ¹ Results expressed as proportion (percentage) overweight dogs in each response category. CI, confidence interval. Modified Bonferroni correction
361 applied, so statistical significance considered when $P < 0.0017$. Results reaching statistical significance are highlighted in bold.