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Impact of canine overweight and obesity on health-related quality of life

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ABSTRACT

Canine obesity is increasing in prevalence in the UK and raises concerns about dog welfare. This study compares the health-related quality of life (HRQL) of dogs of varying body condition: overweight and obese (BCS 4 and 5) versus non-overweight dogs (BCS 2 and 3), obese (BCS 5) versus non-overweight (BCS 2 and 3) and an overall comparison between all four BCS (BCS 2, 3, 4 and 5) using a novel, validated HRQL instrument which is both web and mobile tablet/phone app based.

Of 271 dog owners who were approached, 174 completed a web-based instrument (2013) or a mobile tablet app instrument (2014) during the summers of 2013 and 2014. Automatically generated scores in four domains of HRQL (energetic/enthusiastic, happy/content, active/comfortable, calm/relaxed) were compared for dogs with each of the body condition scores (BCS 2–5). For all body condition scores a statistically significant difference was found between the HRQL scores in two of the domains: energetic/enthusiastic ($p = 0.02$) and active comfortable ($p = 0.004$). When BCS 2 and 3 were compared to BCS 4 and 5, statistical significance was found in the same two domains – energetic/enthusiastic ($p = 0.01$) and active comfortable ($p = 0.001$) – as it was in comparison of non-overweight (BCS 2 and 3) compared to obese dogs (BCS 5): energetic/enthusiastic ($p = 0.012$) and active comfortable ($p = 0.004$).

These results suggest that overweight and obese dogs have a reduced HRQL in two of the domains compared to non-overweight dogs, and that differences in HRQL are detectable between BCS scores 2, 3, 4 and 5.

1. Introduction

Obesity is a malnutrition problem resulting in an excess of adipose tissue that leads to detrimental pathology (German, 2006). It is a state of positive energy balance, caused by an imbalance between energy intake and energy expenditure (German, 2006). A dog is considered to be obese when its body weight exceeds optimum weight for body size by fifteen percent (Laflamme, 2001; Simpson et al., 1993). Some believe that obesity should be considered a medical disease (German, 2011) and define it as a complex and treatable clinical syndrome with reversible metabolic, hormonal and morphological changes (Bray, 1985; Crane, 1991).

The incidence of obesity has a high prevalence in Western countries (German, 2006) with between 25% and 59% of pet dogs in the UK considered to be overweight/obese (Courcier et al., 2010; German, 2015; Holmes et al., 2007; Sandøe et al., 2014). Obesity is a complex condition that may be caused by a combination of factors including, but not limited to, genetic, environmental, metabolic, iatrogenic, socio-demographic, owner and lifestyle aspects (Courcier et al., 2010; Degeling et al., 2012; German, 2006; Gossellin et al., 2007; Laflamme, 2006).

Obesity and its associated clinical diseases are some of the most common seen in practice (German et al., 2012; Yeates and Main, 2011). Associated diseases include osteoarthritis (Blagojevic et al., 2010; Kealy et al., 1997), type II diabetes mellitus (Guh et al., 2009), lung problems (Bach et al., 2007; Manens et al., 2012), urinary and reproductive disorders (German, 2006; Gregory, 1994; Lekcharoensuk et al., 2001), among others. Obesity (and the clinical conditions which can arise as a result) not only impact on health, but also welfare and quality of life (German et al., 2012). A study using a previously validated structured questionnaire instrument

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found that quality of life was reduced in obese dogs and improved with successful weight loss (German et al., 2012).

The quality of life of people is most commonly conceptualized as a subjective perception of wellbeing for which the patient should be the primary source of information (Sprangers and Aaronson, 1992; Sneeuw et al., 2002). Health Related Quality of Life (HRQL) has been defined as 'a combination of health states and affective responses to problems in health status' (Theunissen et al., 1998) and has been increasingly used as an important health status and outcome measure in human medicine.

In the case of companion animals, as with human patients who are incapable of self-report, the challenge is to access the subjective experience of that subject. Various questionnaire instruments for evaluating quality of life have been validated for use in infants through the use of parents/guardians as the respondents (Lewis-Jones et al., 2001; Connolly et al., 2002; Meral and Fidan, 2015). Similarly in dogs HRQL assessment should be carried out by an individual with the greatest knowledge of the dogs' preferences, habits and routine (McMillan, 2000). Assessing the HRQL of animals is important for veterinary medicine. It has the potential to provide veterinary surgeons with information which could contribute to decision-making in relation to treatment options, including euthanasia, as they seek to make ethical decisions to ensure the welfare of the animal. Although vets should be able to undertake any assessment in a detached and professional manner, it may be difficult for them to judge accurately the HRQL of an animal since they are not familiar with that animal's normal behavior and are not able to observe that behavior in the animal's usual environment. Conversely, although the owner is familiar with the animal and is able to observe the animal in its usual environment, the owner will not be impartial. Therefore a method of capturing relevant owner observations while guarding against the potential bias of the respondent is where the value of a well-designed HRQL questionnaire instrument lies. HRQL is impacted by many chronic and life-limiting diseases in animals. Several HRQL questionnaire instruments have been developed to measure HRQL in healthy animals (Lavan, 2013; Reid et al., 2013) and for specific disease conditions such as cardiac disease (Freeman et al., 2012), cancer (Yazbek and Fantoni, 2005; Villalobos, 2011), atopic dermatitis (Favrot et al., 2010), and osteoarthritis (Wiseman-Orr et al., 2004, 2006). Data assessing whether overweight and obese dogs have reduced HRQL compared to non-overweight dogs is currently not available. This is important to establish as if this is found to be the case, it may provide a persuasive argument to key stakeholders including veterinarians, pet owners and the pet food industry, to take action to tackle this problem.

Therefore, the aim of this study was to investigate whether HRQL is reduced in dogs that are overweight and obese compared to non-overweight dogs using two versions of an online structured questionnaire instrument.

2. Materials and methods

2.1. Sample population

Dogs were recruited from The People's Dispensary for Sick Animals (PDSA) PetCheck and council microchipping vans across the UK in the summers of 2013 and 2014. These offered a free service, open to all dog-owning members of the general public across the UK, aiming to provide general advice on the health and welfare of the animal. Owners were approached and were recruited solely on their willingness to participate, providing a convenience sample from the UK dog-owning population. All participants gave consent. Approval for this study was granted by the University of Glasgow School of Veterinary Medicine Ethics and Welfare Committee.

2.2. Body condition scoring

The body condition score (BCS) for each dog was assessed using an established methodology which uses a 5 point scale to assess the amount of body fat covering the dogs' body: 1 is emaciated, 2 is lean, 3 is ideal, 4 is overweight, 5 is obese (Edney and Smith, 1986). For consistency, all dogs were body condition scored only by JLC in 2013 and GN in 2014.

2.3. Assessment of HRQL

Assessment of HRQL was by means of a novel online questionnaire instrument (VetMetrica) designed to measure canine HRQL on a continuum from poor to excellent, using owner responses to a number of simple questions which generate HRQL scores in four domains: energetic/enthusiastic, happy/content, active/comfortable, calm/relaxed. The 22-item instrument used in this study was shortened from a web-based 46-item instrument which itself was developed from an original paper-based prototype with 109 items.[1] The original prototype was validated as a measure of chronic pain through its impact upon HRQL, for dogs with chronic degenerative joint disease (Wiseman-Orr et al., 2004, 2006). Sixty items from that prototype were used to form a paper-based instrument that was used to demonstrate generic HRQL impact in a study of obese dogs before and after weight loss (German et al., 2012). The instrument itself incorporated a range of design features that were designed to minimise the risk of respondent bias, such as considerations of number, type and arrangement of items (Wiseman-Orr et al., 2004), and delivery method.

All owners and their pets were registered to use the VetMetrica instrument whilst in attendance at the PetCheck or microchipping vehicles, given the website link, a username and password, and asked to complete either a 46-item HRQL instrument (Reid et al., 2013) online at home (during summer of 2013) or a shorter instrument containing 22 of the original 46 items (paper in preparation) presented on site on a mobile tablet app (during summer of 2014). If more than one person accompanied the dog, then the primary care-owner was asked to complete the instrument.

In each case the instrument items were simple descriptive terms, some positive (words associated with healthy states) and some negative (words associated with unhealthy states). Each descriptor was associated with a 7-point (0–6) Likert-type scale which allowed owners to rate the extent to which the term described their dogs. For example, for the term 'active', 0 represents 'not at all active' and 6 represents 'couldn't be more active'. A score of 6 implied very good HRQL in the case of a positive descriptor (such as 'active', 'playful' or 'relaxed') or very poor HRQL in the case of a negative descriptor (such as 'sad', 'lethargic' or 'stiff') (Reid et al., 2013; Wiseman-Orr et al., 2004, 2006). The relationship of items to domains is obtained from factor analysis, with domain scores being the average of all ratings (suitably transformed) for items contributing to that domain. For dogs whose owners completed the 22-item shortened instrument, a coded algorithm automatically created a score profile for four domains of HRQL for each dog, based on item ratings given by the dogs' owner. These domains were energetic/enthusiastic, happy/content, active/comfortable, calm/relaxed. Where the 46-item instrument had been completed, data for those 22 items comprising the shorter instrument were extracted, and the same algorithm applied to provide a profile of scores in the same four domains, to allow data collected during both collection periods to be combined.

[1] See: www.vetmetrica.com (accessed 11 March 2015).

2.4. Statistical methods

All data for analysis were stored in an Excel (Microsoft Office 2011) spreadsheet. Data were available for those dogs whose owners completed the questionnaire. Initially, dogs were categorised according to their BCS (BCS 2, 3, 4 or 5). For further analysis the same dogs were categorised as non-overweight (BCS 2 and 3), overweight/obese (BCS 4 and 5) or obese (BCS 5). All statistical analyses were carried out using Minitab v.17 (Minitab Inc.).

Descriptive statistics were generated to compare scores for energetic/enthusiastic, happy/content, active/comfortable and calm/relaxed in each of the populations. The Kruskal-Wallis test was performed to identify associations between all four BCS and scores in each of the four domains of HRQL. Mann-Whitney U tests were used to compare HRQL scores for non-overweight dogs with those for overweight/obese dogs and obese dogs. Box-plots were produced for each relationship of the four domains of HRQL. Statistical significance was defined as $p < 0.05$.

3. Results

Over the summers of 2013 and 2014, a total of 271 dog owners were recruited and subsequently registered to use the VetMetrica instrument. In 2013, 151 people were approached and 35 initially completed questionnaire instruments at home. Two weeks later, the remaining owners were contacted via e-mail and/or phone call. Twenty-four more questionnaires were completed as a result. Four of those originally recruited were found to have invalid e-mail addresses or phone numbers and the other 88 owners were sent text message reminders three weeks later. A further seven questionnaires were completed, leading to a total of 66 (43.7%) completed questionnaires. Of the initial 151 owners who had verbally agreed to take part in the study, 81 remained unresponsive.

In 2014, of 152 people who were approached, 108 completed the HRQL assessment immediately, on site. Those who did not agree to complete the HRQL assessment gave as a reason that they were not interested, did not have enough time or were unwilling to use the tablet. Data from 2013 and 2014 was combined, resulting in data for a total of 174 dogs being available for analysis.

Of the 174 dogs (Table 1), 7% were BCS 2, 56% were BCS 3, 25% were BCS 4, and 12% were BCS 5. Forty percent (n = 69) were female (38% neutered). Sixty percent (n = 105) were male (37% neutered). Dogs ranged in age from 2 months to 15 years (median 3 years). The five most common breeds were Labrador Retriever (12%), Border Collie (7%), Staffordshire Bull Terrier (6%), Lhasa Apso (5%) and Jack Russell Terrier (5%), with crossbreeds accounting for 28%.

Analysis of relationship between HRQL scores and BCS as four separate categories (BCS 2, 3, 4 and 5) (Table 2) shows that higher BCS is associated with lower scores for energetic/enthusiastic and active/comfortable ($p = 0.02$ and $p = 0.004$ respectively) (Fig. 1, Table 3). Significantly lower scores for energetic/enthusiastic ($p = 0.01$) and active/comfortable score ($p = 0.001$) were found between ideal (BCS 2 and 3) and overweight/obese dogs (BCS 4 and 5) (Table 3). Finally, significantly lower scores for energetic/enthusiastic and active/comfortable ($p = 0.012$ and $p = 0.004$ respectively) were found when comparing ideal (BCS 2 and 3) versus obese dogs (BCS 5) (Table 3). Statistically significant differences were not found in the HRQL domains happy/content or calm/relaxed in any of the analyses.

Table 1
Characteristics, including age, breed and sex, of the 174 study dogs recruited for assessment of Health Related Quality of Life across different body condition scores (BCS).

	BCS 2	BCS 3	BCS 4	BCS 5	Total (%)
SEX					
Male Neutered	3	17	10	9	39 (22%)
Male Entire	7	42	17	–	66 (38%)
Female Neutered	–	13	7	6	26 (15%)
Female Entire	3	25	10	5	43 (25%)
AGE					
0–3 years	12	60	17	4	93 (53%)
4–7 years	1	23	17	9	50 (29%)
≥8 years	–	13	10	7	30 (17%)
Unknown	–	1	–	–	1 (1%)
BREED[a]					
Border Collie	2	8	1	1	12 (7%)
Cavalier King Charles Spaniel	–	1	3	1	5 (3%)
Crossbreed Large	1	11	–	2	14 (8%)
Crossbreed Medium	1	8	7	1	17 (10%)
Crossbreed Small	1	12	4	–	17 (10%)
Jack Russell	–	5	–	3	8 (5%)
Labrador Retriever	1	8	6	6	21 (12%)
Lhasa Apso	2	2	5	–	9 (5%)
Shih Tzu	–	5	2	–	7 (4%)
Siberian Husky	2	3	–	–	5 (3%)
Springer Spaniel	1	2	1	1	5 (3%)
Staffordshire Bull Terrier	–	5	4	2	11 (6%)
Yorkshire Terrier	–	4	2	–	6 (3%)

[a] The following Breeds had less than 5 representatives in total and are not listed in the table: American Akita, Bearded Collie, Bichon Frise, Border Terrier, Boston Terrier, Boxer, Cairn Terrier, Chihuahua, Cocker Spaniel, Dalmation, English Pointer, Field Spaniel, German Shepard, Golden Retriever, Miniature Schnauzer, Munsterlander, Papillon, Pug, Toy Poodle, West Highland Terrier and Whippet.

Table 2
Comparison of the four measured domain of health related quality of life, energetic/enthusiastic, happy/content, active/comfortable/and calm relaxed, for body condition scores 2, 3, 4 and 5. Data are for 174 dogs included in the study.

	BCS 2	BCS 3	BCS 4	BCS 5
Energetic/Enthusiastic				
Mean	5.64	5.37	5.24	4.91
Median	5.78	5.67	5.44	5.06
Range	1.67	4.78	2.89	2.89
Minimum/maximum	4.33/6.0	1.22/6.0	3.11/6.0	3.11/6.0
Standard Deviation	0.45	0.76	0.68	0.90
Happy/Content				
Mean	5.32	5.41	5.38	5.35
Median	5.14	5.71	5.57	5.43
Range	1.71	3.29	3.29	1.86
Minimum/maximum	4.29/6.0	2.71/6.0	2.7/6.0	4.14/6.0
Standard Deviation	0.63	0.69	0.68	0.59
Active/Comfortable				
Mean	5.59	5.36	5.06	4.93
Median	5.67	5.67	5.33	5.00
Range	1.00	5.67	3.50	2.83
Minimum/maximum	5.17/6.0	0.33/6.0	2.5/6.0	3.17/6.0
Standard Deviation	0.38	0.84	0.86	0.76
Calm/Relaxed				
Mean	4.46	4.66	4.94	4.90
Median	4.33	4.67	5.33	5.00
Range	3.33	5.00	4.00	2.67
Minimum/maximum	2.67/6.0	1.0/6.0	2.33/6.0	3.33/6.0
Standard Deviation	1.11	1.11	1.16	0.97

4. Discussion

This study demonstrated a statistically significant difference in two domains of HRQL – energetic/enthusiastic and active/comfortable – between non-overweight dogs compared with dogs that were overweight/obese and those that were obese. In addition the results show that there were statistically significant differences in scores for HRQL domains energetic/enthusiastic and active/comfortable domains between dogs with BCS 2–3, 3–4, and 4–5.

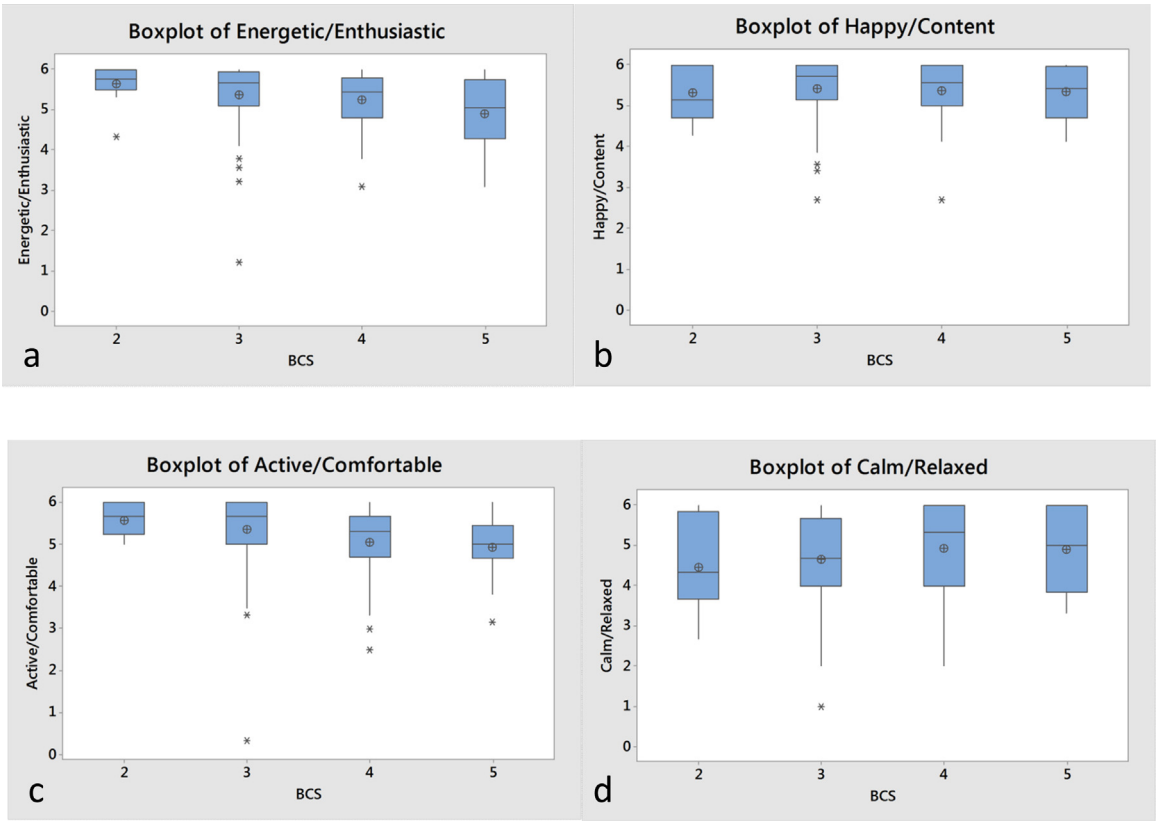

Fig. 1. Box plots showing the relationship between all four BCS and the domains of HRQL—(a) energetic/enthusiastic, (b) happy/content, (c) active/comfortable, (d) calm/relaxed.

Table 3
P values generated for BCS as 4 categories (BCS 2, 3, 4 and 5), BCS as 2 categories (BCS 2 and 3 versus BCS 4 and 5) and BCS 2 and 3 (ideal) versus BCS 5 (obese) for all four HRQL domains.

HRQL Domain	BCS 2, 3, 4 & 5	BCS 2&3 vs 4&5	BCS 2&3 vs 5
Energetic/Enthusiastic	p = 0.020	p = 0.010	p = 0.012
Happy/Content	p = 0.813	p = 0.580	p = 0.527
Active/Comfortable	p = 0.004	p = 0.001	p = 0.004
Calm/Relaxed	p = 0.298	p = 0.079	p = 0.422

The study used a novel, web-based questionnaire instrument to measure canine HRQL, with automated production of an HRQL score profile (Reid et al., 2013), now in a shorter form (22-items) (unpublished) for presentation on a mobile phone/tablet app. Mobile devices offer many advantages in health care (Ventola, 2014). The instrument was used to generate, for each dog, a score profile in four domains of HRQL: energetic/enthusiastic, happy/content, active/comfortable, calm/relaxed. Body condition scoring used a 5-point BCS scale which was considered adequate for a simple comparison of overweight and obese dogs with non-overweight dogs. BCS 2 and 3 were grouped together as 'ideal' because previous studies have shown that slightly underfed dogs have a prolonged lifespan, implying that the ideal BCS has shifted to the left (Kealy et al., 2002).

Energetic/enthusiastic HRQL domain showed a statistically significant decrease in HRQL with BCS from 2 to 5, and this was also shown when comparing non-overweight to overweight/obese dogs and when comparing non-overweight to obese dogs. Reduced scores in this domain might be explained by the capacity for playful and other non-essential activity being reduced as excess weight increases. The same pattern is seen with scores for the active/comfortable domain. This domain captures a dogs' ability to move easily and without pain, and so reduced scores in this domain may reflect not only reduced mobility for mechanical reasons but also possible joint pain, both potentially worsening as excess weight increases.

No statistically significant difference was found in scores for calm/relaxed or happy/content domain for any of the three analyses. The range of scores in the calm/relaxed domain was larger than in other domains, and overweight/obese dogs also had a greater median score than non-overweight dogs for this domain; it is possible that variability in this domain is to a larger extent than other domains affected by a dogs' temperament, which is a stable attribute, and so is less liable to be affected by some impacts on health. It may also be that the suppression of activity often seen in overweight dogs is being misinterpreted by owners. Happy/content shows the lowest median score for dogs with BCS 2 and 5 with the highest median score for dogs with BCS 3, suggesting that an ideal bodyweight is associated with high levels of contentment. However, no statistical significance was shown.

These results indicate that overweight/obese dogs may be significantly less active/comfortable with lower energy levels than non-overweight dogs. Studies have shown similar findings in obese children, adolescents (Schwimmer et al., 2003), and adults (Jia and Lubetkin, 2005; van Nunen et al., 2007) with the obese participants having a lower HRQL than non-overweight individuals. Factors such as poorer functional status (walking, working and climbing stairs), chronic pain, and increased levels of anxiety and depression may account for this reduced HRQL (Fontaine and Barofsky, 2001). A study by Karlsson et al. (2007) showed that HRQL of obese people could be greatly improved through weight loss over a ten-year period. Similarly, in a longitudinal study in dogs, HRQL was low in obese dogs but improved with successful weight loss; improved

vitality and emotional well-being, and decreased pain scores were seen (German et al., 2012).

The current study uses a web-based instrument for the assessment of canine generic (not disease-specific) HRQL and has been shown to be an effective tool for measuring HRQL in obese dogs. It is of interest that the instrument could detect differences in HRQL between BCSs (BCS 2, 3, 4 and 5) as well as the more gross changes (healthy vs overweight/obese, and healthy vs obese), so that it may be possible to use the instrument to demonstrate to owners that even moderate increases in weight are deleterious. Furthermore, many dog owners find it difficult to persevere with weight reduction diets for their dogs (Laflamme and Kuhlman, 1995): regular HRQL measurement using an instrument that can be completed very rapidly at home and provide instant scores output for owners may provide them with additional motivation to continue by reminding them regularly of the impact of obesity on the quality of life of their dog and by showing them how this can improve as the dog loses weight.

There were several strengths and weaknesses of the study. The PDSA Pet Check (a vehicle travels around the UK and veterinary nurses give free health check and health advice to owners) is a free service provided by the charity to promote pet health in the UK. Similarly the microchipping service was free and aimed to promote responsible pet ownership. Since the participants in this study were recruited from these services, the sample of dogs and owners was reasonably random, more so than if they had been recruited from those attending a veterinary practice, but may not be representative of the owners likely to use veterinary services routinely and may not be representative of the entire UK dog-owning population and hence results should be interpreted with caution. The sample population contained a range of breeds and ages of dogs (Table 1). It is possible that the variation in both age and breed of dogs recruited could have affected the domain scores. It is also possible that further significant differences exist that we were unable to detect during this study due to a lack of statistical power. Additionally there was no full clinical history available: it is conceivable that dogs in the non-overweight category may have had disease conditions that lowered their quality of life, which could affect the results. Despite the potentially highly variable nature of these dogs, statistically significant differences between dogs with different BCS was able to be detected.

Secondly, respondent bias is always an issue when seeking information from pet owners. Owners in this study were informed that the study was an investigation about quality of life of dogs, which is itself likely to bias respondents. However, owners were not told that the study related to body condition in dogs. Online instruments have been shown to minimize respondent bias when compared with paper delivery (Peer and Gamliel, 2011). Online delivery of questionnaires tends to be cost-effective, have quicker return rates, offer efficient data management and can cover a wider geographical range (Denscombe, 2009; Holmes, 2009).

Of benefit is that the questionnaire instrument is quick and easy to use, and allows owners to complete the questionnaire in the dogs' natural environment (Reid et al., 2013). Automatic data capture, computation of scores and simultaneous reporting of results, increases the utility of the instrument (Reid et al., 2013). Previous studies have indicated that participant response is significantly higher among those who choose online questionnaires rather than postal questionnaires (Smith et al., 2013). However, during phase 1 data collection in 2013, a small number of potentially willing participants (2) were precluded from taking part since they did not have email access. This issue is likely to decrease over time as more people access the internet; in 2014, 76% of adults in Great Britain accessed the Internet everyday (Office for National Statistics, 2014). During follow up contact, the main reason reported in 2013 for poor completion was lack of time. Other minor reasons for lack of response included problems with computers, internet connections, or accessing the website. Despite e-mail, phone call and text reminders, the majority of owners recruited during summer 2013 failed to complete the instrument at home. Although this may seem low, it compares favourably with some studies: a broad range of response rates (0.3–96%) to online questionnaires has been reported (Holmes, 2009). Response issues were rectified through allowing owners to complete the instrument on site during data collection in 2014 as owners were able to complete the questionnaire at the time of visiting the PetCheck vehicle. This maximised completion rate and prevented the need for follow up reminders.

This study has shown that overweight and obese dogs have a reduced aspects of HRQL compared to dogs that are not overweight. It is well described that the causes of obesity are complex and multifactorial (Gossellin et al., 2007; Laflamme, 2006; Robertson, 2003) yet to date, despite many health campaigns (PDSA, 2014a; Pet Food Manufacturers Association, 2014; The Kennel Club, 2014), obesity seems to be an ongoing problem with a high prevalence (80% of veterinarians agree that there will be more obese than healthy pets in five years' time (PDSA, 2014b)). Bland et al., 2010 specifically noted that owners resist weight management plans in part over concerns that the animal might suffer, so the results from this study could alleviate concerns from those particular owners. Our findings, which demonstrate a decreased quality of life in overweight and obese dogs, may be a factor in helping owners and veterinarians take more decisive action in battling this issue.

5. Conclusions

The web-based HRQL questionnaire detected a statistically significant difference between overweight/obese and non-overweight dogs, between non-overweight and obese dogs and between dogs increasing in BCS from 2 to 5. This study provides evidence that overweight and obese dogs have reduced HRQL, which gives weight to existing efforts to tackle obesity in the canine population on welfare grounds. The study also highlights the value of a novel HRQL instrument that may support veterinary efforts to do so.

Conflict of interest

Authors Reid and Wiseman-Orr are Directors in NewMetrica Ltd., a company specializing in the development of instruments to measure pain and quality of life in non-verbal populations.

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