

Evaluation of a Weight Management Food Designed to Increase Basal Metabolism in a Home Setting

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ABSTRACT

Decreasing calorie intake is the principle strategy for weight loss in overweight or obese pets. Pet owner behaviors such as noncompliance and overfeeding are often cited as reasons for failure of in-home weight management programs. This study evaluated the effectiveness of a weight management food designed to increase basal metabolism of client-owned, overweight dogs (n=159, mean age 6.8 years) and cats (n=155, mean age 6.7 years) with a body condition score (BCS) ≥ 4 (5-point scale) in a home setting in the absence of specific instructions to change lifestyle or exercise routines to facilitate weight loss. The daily ration of the test food to achieve ideal body weight were estimated by use of a recently described morphometric measurement method and online tool. Each pet completed the study after being fed the test food for 60 days following an initial 7-day transition

period. While 96% of dogs and 81% of cats lost weight by the end of the study, only 77% of dog owners and 52% of cat owners perceived that weight loss occurred in their pets. A survey of participating owners found that 77% and 59% of dog and cat owners, respectively, said the food was "an easy way for their pet to lose weight," and 67% and 63% of dog and cat owners, respectively, said the food "kept their pets feeling full and satisfied." This study demonstrated that providing a specific nutritional recommendation based on an accurate assessment of ideal body weight for a food designed to increase basal metabolism results in successful in home weight loss in overweight dogs and cats with minimal intervention by the veterinary health care team.

INTRODUCTION

Obesity is considered the most common nutritional disease of dogs and cats.(Bland et al, 2009; Mawby et al, 2004; McGreevy et al, 2005; and Michel and Scherk, 2012). The rate of obesity or overweight in adult

dogs and cats in developed countries ranges from 25% and 45%, with even higher rates in pets between 5 and 10 years of age. (Bland et al, 2010; Donoghue and Scarlett, 1998; Klausner and Lund, 2012; Laflamme, 2006; Lund et al., 2005; Lund et al., 2006; McGreevy et al., 2005; Michel and Scherk, 2012; and Scarlett and Donoghue, 1998) Excess weight in dogs and cats is linked to shortened lifespan and an imposing list of comorbidities. These include strong associations between pet obesity and chronic conditions such as diabetes, lameness, immune dysfunction, feline urolithiasis, cardiovascular disease, hypertension, and kidney disease. (Linder and Freeman, 2010; Michel and Scherk, 2012; Scarlett and Donoghue, 1998; and Toll et al, 2010) Perhaps more importantly from the owner's perspective, is the fact that overweight pets are suffering as a result of this disease and successful management relieves suffering. Results of a recent study confirm overweight dogs that successfully lost weight had significant improvement in vitality and reduced pain and emotional disturbance compared to dogs that failed to complete a weight management program. (German et al, 2012) Veterinary behaviorists also note that canine and feline obesity takes a toll on the quality of the pet-family bond by detracting from the pet's heat and exercise tolerance, willingness to play, and interaction with its owner. (McGreevy et al, 2005)

Unfortunately, only a small percentage of dogs and cats, even those fed a therapeutic weight-loss food, successfully lose weight in the home environment. (Kienzle and Bergler, 2006; Roudebush et al, 2008) Failure of pet weight-management programs is generally attributed to owner behaviors beyond the control of the veterinary health care team. (Bland et al., 2010; Kienzle et al., 1998) A survey of Australian veterinary health care provider opinions reported that veterinarians believe the overwhelming majority (97%) of canine obesity cases are related to human factors such as owner-administered diets, exercise routines, and owner attitudes. (Bland et al., 2010) In many

ways, pet obesity can be considered a disease of human behavior. (Cave, 2012) Thus, one of the challenges of clinical practice is to be able to implement a weight-management program that has a high success rate in spite of circumstances that may exist in the home environment.

The objective of this study was to determine the success rate of weight loss in overweight dogs and cats in a home setting when owners were provided a specific nutritional recommendation based on an accurate assessment of ideal body weight for a novel therapeutic weight management food designed to increase basal metabolism even in the absence of specific instructions to change lifestyle or exercise routines to facilitate weight loss.

METHODS

Study Design

The study was approved by the sponsor's Institutional Animal Care and Use Committee and adhered to the Hill's Global Animal Welfare Policy. This was a non-controlled feeding study of overweight client owned dogs and cats. Veterinary care givers and pet owners were blinded to the identity of the study sponsor and manufacturer of the test food. Pets were screened for eligibility based on body condition score (>4 on a 5 point scale) (Thatcher et al., 2010). Exclusion criteria included:

- stray or shelter-owned animals
- females that were pregnant, lactating, or breeding
- being less than 1 year of age
- current use of any treatment or food that could affect appetite or changes in weight; history of food allergy / intolerance
- current use of urinary acidifiers
- current use of a therapeutic pet food; and history or evidence of any overt clinical disease.

Initial body condition scores (BCSs), ideal body weight, and food doses were determined by participating veterinarians, who dispensed the test food to clients for in-home

Table 1. Nutrient composition of the novel weight management test food^a

	Canine Formula		Feline Formula	
ME kcal/kg	3,096		3,419	
ME kjoules/kg	12,954		14,305	
Nutrient	% DM	g/100 kcal	% DM	g/100 kcal
Protein	30.1	8.9	38.7	10.7
Fat	10.8	3.2	13.1	3.6
Total Dietary Fiber	28.6	8.5	16.4	4.5
Ash	6.3	1.9	6.6	1.8

ME= metabolizable energy, % DM= % Dry Matter

feeding. A recently described morphometric measurement method and a nonbranded online tool were used to estimate ideal body weight and calculate the daily food dose. (Witzel et al., 2014a, b) The daily food dose was calculated by the online tool using the following formulas; Dogs: 1 x RER for ideal body weight and Cats: 0.8 X RER for ideal body weight. (Toll et al., 2010) Food dose was not adjusted during the study period.

Owners were given written instructions to feed the primary pet individually using the test food as the sole food and not to feed any canned food or unhealthy snacks such as table scraps. Owners agreed to transition their pets onto the test food using a blended ration for an initial 7-day period, and to then feed the test food at the recommended dose exclusively for the remainder of the study. Owners presented the pet for physical examination and body weight within 3 days of the scheduled day 37 and 67 evaluations. Each pet was considered to have completed the study after being fed the test food for 60 days following the initial 7-day transition

period. Prior to each evaluation period, the pet owner was asked to complete the online opinion survey. Percent body weight loss was calculated at each recheck ($[(\text{Recheck weight} - \text{Day 0 weight}) / \text{Day 0 weight}] \times 100$) and used to determine percent body weight loss per week (Percent body weight loss (as calculated above) / number of days pet owners declared the test food was fed exclusively $\times 7$). For each species, average percent body weight loss per week was calculated (Sum of all cats' (dogs') percent body weight loss per week / Total number of cats (dogs)).

While the veterinarians understood they were making a specific nutritional recommendation for weight loss, owners were informed their pet would receive a therapeutic food designed for pets with body compositions similar to their pet. Owners did not receive specific instructions to change lifestyle or exercise routines to facilitate weight loss, but did agreed feed the test food as the sole source of nutrition. Once the food was dispensed, nutritional management be-

Table 2. Distribution of Initial Percent Body Fat* in Dogs and Cats

	29-34%	35-44%	45-54%	55-64%	> 65%
Dogs n= 159	14	55	68	18	4
Cats n= 155	10	33	69	40	3

Based on morphometric measurements, 72% of cats and 56% of dogs were estimated to have $\geq 45\%$ body fat at the time of enrollment.

*Percent body fat based on morphometric measurements

came the sole responsibility of the pet owner, with no clinical intervention. In addition, owners of pets from a same-species, multi-pet household were given the option of feeding the test food to up to three additional pets provided the pets met the eligibility requirements of the study. Only the primary pet was monitored and evaluated for study purposes. Feeding regimens for non-primary pets were determined by the attending veterinarian and were not recorded.

Test Food

The test food was a commercially manufactured dry pet food containing AAFCO-approved ingredients suitable for adult lifestage nutritional requirements for dogs and cats.a (Table 1). The test food was dispensed to participating pet owners in dry-food form in an unbranded bag with an 8-ounce measuring cup. Attending veterinarians dispensed the test food in two increments to participating pet owners. The first allotment consisted of enough test food for the first 30 days of the study plus a 7-day transition period. When owners presented their pet for the day-37, mid-study visit, they received an additional supply of test food sufficient for the remainder of the study. Additional test food was provided if needed between scheduled visits.

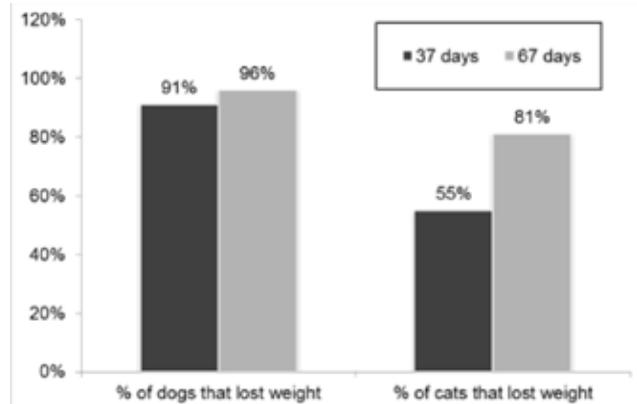
Statistical Analysis

Univariate analysis was used to describe the distribution of body composition of enrolled pets, the percent of pets that lost weight during the 2-month study and the observations and perceptions of the owners as captured by the survey questions.b

RESULTS

This study enrolled 351 client-owned overweight pets (176 dogs and 175 cats). Seventeen (17) dogs and 20 cats were excluded for failure to return for evaluation at specified intervals or failure to complete the

Figure 1. Percentage of dogs and cats that lost weight 37 and 67 days after being fed a weight management food^a

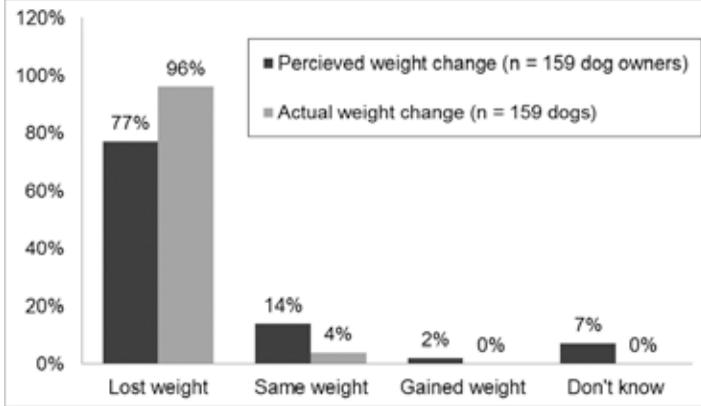


The percentage of dogs that lost weight at the 37- and 67-day intervals was little changed. Cats experienced a much greater disparity in the percentage that lost weight at the 37- and 67-day intervals.

survey. No owners reported adverse events as the cause for withdrawal from the study. A final population of 159 dogs and 155 cats completed the study and were considered in the outcomes data. Study dogs included 85 different breeds or mixed-breed combinations that ranged in age from 2 to 15 years (mean, 6.8 years). Study cats included 8 different breeds or mixed-breed combinations that ranged from 2 to 14 years of age (mean 6.7 years). Households with multiple pets of the same species were eligible for participation, but only one primary pet from each household was enrolled in the study. Study food was provided for additional same species pets in 54 dog (34%) and 85 cat (55%) households.

Distribution of initial percent body fat as determined by morphometric measurements is shown in Table 2. Over half (56%) of dogs and almost three quarters of cats (72%) had 45% or greater body fat. Of the 314 pets that completed the study, 88% (276/314) of pets lost weight at the conclusion of the study. Figure 1 compares the percentage of dogs and cats that lost weight at the 37-day and 67-day intervals. Dogs lost weight at an average rate of 0.8% and cats at 0.5% of starting body weight (SBW) per week. Pet owners underestimated the percentage of pets that lost weight based on their end-of-

Figure 2. Perceived versus actual weight loss in dogs fed a weight management fooda for 67 days.



Pet owner perception of the percent of dogs that lost was lower than the actual percent of dogs that lost weight.

study survey responses. Although 96% of dogs lost weight, only 77% of dog owners perceived that a weight loss occurred, a relative difference of 25%. The difference in actual versus perceived weight loss was more pronounced for cats.

Eighty-one percent of cats lost weight, but only 52% of cat owners perceived that a weight loss occurred, a 56% relative difference. Pet owners also over-estimated the percentage of dogs and cats that experienced no change in weight. Only 4% of dogs and 7% of cats weighed the same at 67 days as they did on day 0, but 14% of dog owners and 29% of cat owners perceived that no change in weight occurred. None of the dogs gained weight during the study, but 12% of the cats did. Seven percent of dog owners said they did not know if a weight change occurred during the study compared to 17% of cat owners. Figures 2 and 3 compare the final percentage of dogs and cats, respectively that experienced a change in weight versus the percentage of pet owners who perceived that a change in weight

occurred.

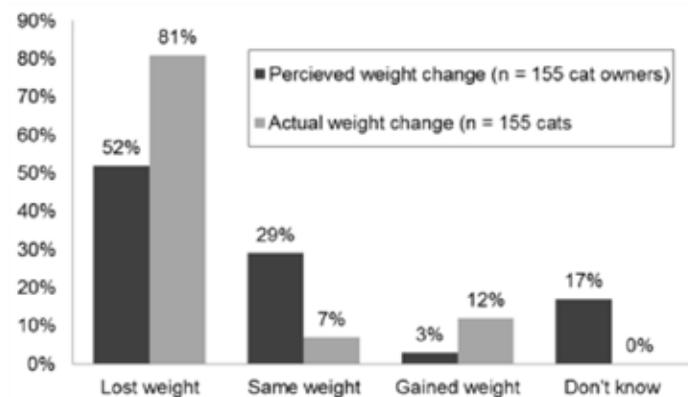
Pet owner attitudes regarding the therapeutic food were generally favorable (Figure 4), although the percentage of dog owners who agreed that the food was “an easy way to lose weight” (77%) and “kept their pets feeling full and satisfied” (67%) was greater than the percentage of cat owners agreeing to the same questions (59% and 63%, respectively). One survey item was devoted

to acceptance of the feline test food, an indication of palatability, and at the 37-day interval 99% responded that “the diet is easy to feed to cats”.

DISCUSSION

Veterinary nutritionists have noted that identifying an overweight dog or cat is easy, but determining the extent of overweight and the patient’s ideal body weight can be challenging. (Toll et al., 2010) It is important for veterinarians to base feeding dose recommendations on an accurate estimate of ideal body weight to avoid over-feeding calories. Basing food dose calculations on

Figure 3. Perceived versus actual weight loss in cats fed a weight management fooda for 67 days.



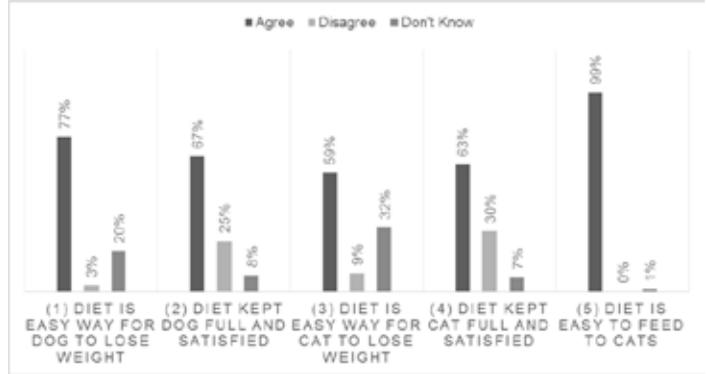
Pet owner perception of the percent of cats that lost was lower than the actual percent of cats that lost weight.

an overestimate of ideal weight decreases success of weight management programs. Traditional body condition scoring systems overestimate ideal body weight in pets with > 40% body fat. Since 64% (202/314) of the pets in this study had >45% body fat, traditional BCS would provide an inaccurate estimate of ideal body weight in the majority of these pets.

The recently described morphometric measurement method used in this study to determine ideal body weight from external body measurements has been shown to have good correlation with dual emission x-ray absorptiometry (DEXA) predicted ideal body weight even in pets with > 40% body fat. (Witzel et al., 2014a, b). Since this method requires no special equipment, only a metric scale measuring tape and digital pet weighing scale it is ideally suited for general practice.

In controlled studies using commercially available therapeutic weight loss foods where food dose calculations were based on ideal body weight as determined by DEXA and where food consumption was closely apportioned and monitored the reported rate of weight loss for dogs ranged from 0.7 – 1.0% of starting body weight per week and for cats at 0.6% of starting body weight per week. (German et al, 2010; German et al, 2012; Tvarijonavičiute et al, 2012) Veterinary nutritionists recommend a weekly rate of 1-2% SBW loss for dogs and a 0.5-1% of SBW for cats. (Toll et al., 2010) More rapid weight loss is considered unhealthy due to risk of nutrient deprivation, loss of lean body mass, and a more aggressive rebound effect when a maintenance diet is introduced after the weight-loss target is achieved. (Nagaoka et al, 2010) Although most pets successfully lost weight in these carefully

Figure 4. Pet owner attitudes after feeding their dog or cat weight management food. ^a



The majority of pet owners believed that the test food was an easy way for their pet to lose weight and kept their pet feeling full and satisfied. When asked if the test food was easy to feed, virtually all cat owners agreed. Items 1 through 4 were surveyed after pets had been fed the test food for 60 days following a 7-day transition period. Item 5 was surveyed at the 37-day interval, 7 days after the transition period.

designed and rigorously controlled studies, this cannot be considered equivalent to what occurs in the context of a typical veterinarian-client-pet relationship.

Other investigators have noted the drop-off in effectiveness of weight-loss foods when they are transposed from controlled research settings to an in-home environment. (Bissot et al, 2010; Kienzle and Bergler, 2006) However in this study, without the use of DEXA to determine ideal body weight, precise weighing and adjusting of food doses or recommendations for owner behavior modification or increased exercise, 88% of pets (91% of dogs and 81% of cats) fed the test food lost weight at rates (0.8% and 0.5% of SBW/week for dogs and cats respectively) equivalent to those reported in the rigorously controlled studies. Unlike the protocol used in rigorously controlled trials, this protocol can be easily incorporated into routine veterinary care visits.

There are several possible explanations for the lower rate of weight loss in feline compared to canine patients observed in this and other studies. Many owners prefer to feed their cats a moist, canned food, or to feed on a continuous, free-choice basis. (Donoghue and Scarlett, 1998; Kienzle et al, 1998) Thus, some cat owners may

have deviated from the study protocol by top-dressing the dry test food with a commercially available canned cat food. More than half the test cats (85/155; 55%) resided in multi-cat households, potentially giving them access to other cats' food resources.

By comparison, only about a third of the test dogs resided in multi-dog households. Additionally, owners are more likely to feed dogs in one to three discrete meals versus continuous feeding decreasing access to other dogs' food resources. (Bland et al, 2009) The high rate of feline acceptance (99%) of the test food was encouraging from a nutritional standpoint given the well-known tendency of cats to be picky eaters, but may have also contributed to overconsumption of calories. (Bradshaw, 2006) These factors (free choice feeding, access to other cats' food, and high acceptance rate) may also explain the small percent of cats that gained weight during the study. For the practitioner, these findings underscore the importance of client counseling on proper feeding practices for cats on a weight management program (client education was not a component of the study protocol).

Traditional therapeutic weight loss foods rely in part on accurate measurements of food dose for successful weight loss. Unfortunately, most pet owners are inaccurate when measuring food doses. One investigator has observed as much as 20% variability in the amount of pet food apportioned by different people using a measuring cup. (Bissot et al, 2010). In a study designed to evaluate the precision and accuracy of using measuring cups to allocate feeding portions, significant variability and inaccuracy was noted. (German et al, 2011) In that study the accuracy of using measuring cups for dry food ranged from 18% underestimate to 80% overestimate in portion size, with the majority overestimating portion size by at least 10%. This inherent inaccuracy in measuring is the reason many weight loss programs require owners to precisely weigh food portions instead of using measuring cups. This requirement can be onerous for

some owners, and may contribute to lack of compliance with a weight management program.

In this study owners were instructed to deliver food doses using a measuring cup. Despite the documented variability of apportioning food with this method, pets successfully weight loss without the need for precisely weighing food doses. The success of this protocol may be attributed in part to the combination of nutrients in the test food which have been shown to positively impacted energy metabolism during weight loss and maintenance, resulting in reduced body fat and increased lean body mass. (Jewell et al, 2014a, b) A noteworthy aspect of this key outcome was that the study population averaged >6.5 years of age. Canine and feline obesity rates increase markedly in pets >5 years of age as metabolic rates decline and exercise limitations occur. (Donoghue and Scarlett, 1998; Michel and Scherk, 2012; Sanderson, 2009; and Toll et al, 2010) Achieving consistent weight loss in this age group becomes clinically important since an estimated 35% of dogs and cats presented at veterinary hospitals are considered "senior," which is typically defined as greater than 7 years of age. (AAHA, 2003)

Pet owner attitudes were an important aspect of this study. If owners perceive a therapeutic food to be burdensome to administer or that treatment response is lacking, they are less likely to comply with feeding guidelines. (Bissot et al., 2010; German et al, 2010; McGreevy et al, 2005) While 96% of dogs and 81% of cats lost weight nearly half of cat owners and almost a quarter of dog owners failed to recognize that their pets had lost weight, an under-estimation that has implications for compliance. Owners whose pets are on a veterinary recommended weight loss program but perceive that their pets are not losing weight may be more inclined to abandon the treatment plan. Day-to-day subjective observation often fails to detect gradual physical changes that are readily apparent when objective criteria are used to document changes in body weight,

underscoring the need for monthly weight checks by the veterinary health care team.

Just prior to the final weighing, more than three out of four dog owners and nearly six out of 10 cat owners agreed that the test food was an easy way for their pets to lose weight (Figure 4). Nearly a third of cat owners said they were unsure if the diet was an easy way to lose weight. Since 52% of cat owners were unaware their pet had lost weight it is conceivable that if the attitude survey been taken after the weight check had confirmed weight loss, a larger percentage of cat owners may have concurred that the test diet was an easy way for their cats to lose weight. Owner-perceived satiety rates were 67% for dogs and 63% for cats. Given that food doses were calculated for weight loss, lack of complete satiety in approximately one out of three pets was not surprising. In addition, many attention seeking behaviors in both dogs and cats are often misinterpreted by owners as a request for food. This is particularly true for owners of overweight pets.(Kienzle and Bergler, 2006; Kienzle et al, 1998)

CONCLUSION

As demonstrated in this study, the morphometric measurement method of estimating ideal body weight and food dose used in the study protocol represents a useful clinical tool easily incorporated into the veterinary practice setting. This study demonstrated that providing a food dose based on an accurate assessment of ideal body weight combined with a specific nutritional recommendation for a food designed to increase basal metabolism results in successful in home weight loss in overweight dogs and cats with minimal intervention by the veterinary health care team or behavior/ lifestyle changes by the owner.

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FOOTNOTES

a Hill's Prescription Diet® Metabolic Advanced Weight Solution, Hill's Pet Nutrition, Topeka, Kansas, U.S.A

b Survey questions available upon request

REFERENCES

1. AAHA, 2003. The Compliance Equation, In: The Path to High-Quality Care: Practical Tips for Improving Compliance. American Animal Hospital Association, Denver, CO.
2. Bissot, T., Servet, E., Vidal, S., Deboise, M., Sergheraert, R., Egron, G., Hugonnard, M., Heath, S.E., Biourge, V., German, A.J., 2010. Novel dietary strategies can improve the outcome of weight loss programmes in obese client-owned cats. *Journal of feline medicine and surgery* 12, 104-112.
3. Bland, I.M., Guthrie-Jones, A., Taylor, R.D., Hill, J., 2009. Dog obesity: owner attitudes and behaviour. *Prev Vet Med* 92, 333-340.
4. Bland, I.M., Guthrie-Jones, A., Taylor, R.D., Hill, J., 2010. Dog obesity: veterinary practices' and owners' opinions on cause and management. *Prev Vet Med* 94, 310-315.
5. Bradshaw, J.W., 2006. The evolutionary basis for the feeding behavior of domestic dogs (*Canis familiaris*) and cats (*Felis catus*). *The Journal of nutrition* 136, 1927S-1931S.
6. Cave, N.J., 2012. The Human Factor to Feeding Pets, In: ACVIM Forum, New Orleans, LA.
7. Donoghue, S., Scarlett, J.M., 1998. Diet and feline obesity. *The Journal of nutrition* 128, 2776S-2778S.
8. German, A.J., Holden, S.L., Bissot, T., Morris, P.J., Biourge, V., 2010. A high protein high fibre diet improves weight loss in obese dogs. *Vet J* 183, 294-297.
9. German, A.J., Holden, S.L., Mason, S.L., Bryner, C., Bouldoires, C., Morris, P.J., Deboise, M., Biourge, V., 2011. Imprecision when using measuring cups to weigh out extruded dry kibble food. *J Anim Physiol Anim Nutr (Berl)* 95, 368-373.
10. German, A.J., Holden, S.L., Wiseman-Orr, M.L., Reid, J., Nolan, A.M., Biourge, V., Morris, P.J., Scott, E.M., 2012. Quality of life is reduced in obese dogs but improves after successful weight loss. *The Veterinary Journal* 192, 428-434.
11. Jewell, D.E., Floerchinger, A.M., Jackson, M., MacLeay, J., Paetau-Robinson, I., Hahn, K., 2014a. A reduced calorie, high fiber food with added coconut oil, L-carnitine, lysine and leucine increases basal metabolic rate in overweight and obese cats (Abstract). *Journal of Veterinary Internal Medicine* 28, 1088.
12. Jewell, D.E., Floerchinger, A.M., Jackson, M., MacLeay, J., Paetau-Robinson, I., Hahn, K., 2014b. A reduced calorie, high fiber food with added coconut oil, L-carnitine, lysine and leucine increases basal metabolic rate in overweight and obese dogs (Abstract). *Journal of Veterinary Internal Medicine* 28, 1087-1088.
13. Kienzle, E., Bergler, R., 2006. Human-animal relationship of owners of normal and overweight

- cats. *The Journal of nutrition* 136, 1947S-1950S.
14. Kienzle, E., Bergler, R., Mandernach, A., 1998. A comparison of the feeding behavior and the human-animal relationship in owners of normal and obese dogs. *The Journal of nutrition* 128, 2779S-2782S.
 15. Klausner, J.S., Lund, E., 2012. State of Pet Health 2012. Banfield Pet Hospitals, Portland, OR.
 16. Laflamme, D.P., 2006. Understanding and managing obesity in dogs and cats. *The Veterinary clinics of North America* 36, 1283-1295, vii.
 17. Linder, D.E., Freeman, L.M., 2010. Evaluation of calorie density and feeding directions for commercially available diets designed for weight loss in dogs and cats. *Journal of the American Veterinary Medical Association* 236, 74-77.
 18. Lund, E.M., Armstrong, P.J., Kirk, C., Klausner, J.S., 2005. Prevalence and risk factors for obesity in adult cats from private US veterinary practices. *Intern J Appl Res Vet Med* 3, 88-96.
 19. Lund, E.M., Armstrong, P.J., Kirk, C.A., Klausner, J.S., 2006. Prevalence and Risk Factors for Obesity in Adult Dogs from Private US Veterinary Practices. *Intern J Appl Res Vet Med* 4, 177-186.
 20. Mawby, D.I., Bartges, J.W., d'Avignon, A., Laflamme, D.P., Moyers, T.D., Cottrell, T., 2004. Comparison of various methods for estimating body fat in dogs. *Journal of the American Animal Hospital Association* 40, 109-114.
 21. McGreevy, P.D., Thomson, P.C., Pride, C., Fawcett, A., Grassi, T., Jones, B., 2005. Prevalence of obesity in dogs examined by Australian veterinary practices and the risk factors involved. *The Veterinary record* 156, 695-702.
 22. Michel, K., Scherk, M., 2012. From Problem to Success: Feline weight loss programs that work. *Journal of feline medicine and surgery* 14, 327-336.
 23. Nagaoka, D., Mitsuhashi, Y., Angell, R., Bigley, K.E., Bauer, J.E., 2010. Re-induction of obese body weight occurs more rapidly and at lower caloric intake in beagles. *Journal of Animal Physiology and Animal Nutrition* 94, 287-292.
 24. Roudebush, P., Schoenherr, W.D., Delaney, S.J., 2008. An evidence-based review of the use of therapeutic foods, owner education, exercise, and drugs for the management of obese and overweight pets. *Journal of the American Veterinary Medical Association* 233, 717-725.
 25. Sanderson, S.L., 2009. Canine Obesity - A Treatable Condition. NAVC Clinician's Brief March, 67-71.
 26. Scarlett, J.M., Donoghue, S., 1998. Associations between body condition and disease in cats. *Journal of the American Veterinary Medical Association* 212, 1725-1731.
 27. Thatcher, C., Hand, M., Remillard, R., 2010. Small animal clinical nutrition: an iterative process, In: *Small Animal Clinical Nutrition* 5th Edition. Mark Morris Institute, Topeka, KS, pp. 3-21.
 28. Toll, P.W., Yamka, R.M., Schoenherr, W.D., Hand, M.S., 2010. Obesity, In: *Small Animal Clinical Nutrition*, 5th ed. Mark Morris Institute, Topeka, KS, pp. 501-535.
 29. Tvarijonaviciute, A., Ceron, J.J., Holden, S.L., Morris, P.J., Biourge, V., German, A.J., 2012. Effects of weight loss in obese cats on biochemical analytes related to inflammation and glucose homeostasis. *Domest Anim Endocrinol* 42, 129-141.
 30. Witzel, A.L., Kirk, C.A., Henry, G.A., Toll, P.W., Brejda, J.J., Paetau-Robinson, I., 2014a. Use of a morphometric method and body fat index system for estimation of body composition in overweight and obese cats. *Journal of the American Veterinary Medical Association* 244, 1285-1290.
 31. Witzel, A.L., Kirk, C.A., Henry, G.A., Toll, P.W., Brejda, J.J., Paetau-Robinson, I., 2014b. Use of a novel morphometric method and body fat index system for estimation of body composition in overweight and obese dogs. *Journal of the American Veterinary Medical Association* 244, 1279-1284.