

Research Article

Owner Assessment of Satiety and Begging Behaviors in Overweight Dogs

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Abstract

This study tested if a therapeutic weight loss diet or presentation of diet to owners would influence owners' assessment of their dog's satiety. Twenty-three overweight, but otherwise healthy, dogs were fed their usual diet and then a study diet with both a positive and neutral description in a randomized crossover design. Diets were fed in amounts to meet dogs' resting energy requirements to maintain current body weight. Owners were asked questions on dogs' satiety (e.g., begging, acting hungry) on a 1-5 Likert Scale. When comparing the dogs' usual diet versus neutral description of the study diet and positive vs neutral descriptions of the study diet, there were no statistically significant differences for any survey questions ($P = 0.16-0.75$; $P = 0.31-0.99$, respectively). Wide variation in owner perception was noted for all dog begging behaviors and satiety. Based on this wide variation, individualization of dog weight loss programs could improve success.

Keywords

- Nutrition
- Obesity
- Satiety
- Human-Animal Bond
- Client Communication

ABBREVIATIONS

BCS: Body Condition Score; **RER:** Resting Energy Requirement; **MCS:** Muscle Condition Score

INTRODUCTION

Obesity is one of the most common health problems affecting dogs, with an estimated 34% to 59% of dogs being overweight or obese [1-3]. The risk factors for obesity are multifactorial and include pet-specific factors (e.g., gender, neuter status, breed, etc.) as well as owner-specific factors (e.g., age, income, etc.) [3]. Obesity is a nutritional disorder that is challenging to treat and weight loss is often unsuccessful due to noncompliance even with comprehensive management [4,5]. Owners of overweight pets commonly express concern over their dogs' perceived hunger and this can prevent successful weight loss in some dogs if owners subsequently overfeed or give treats [6]. Since owners typically control the amount of food provided to their dogs, increasing perception of dogs' satiety could improve the success of weight loss programs.

Perceived satiety is likely multifactorial for both dogs and their owners, and includes some dietary factors. Some studies have shown that increased dietary fiber [7,8] or increased dietary fiber and protein [9] improves satiety in dogs. At least one other study, however, showed no effect of fiber on satiety [10]. Limitations of these studies include methods of measuring voluntary food intake and studying dogs in a research colony

setting [7-8,10] and including healthy dogs with a body condition score (BCS) of 4-6 on a 9-point scale [9].

In addition to dietary factors, attitudes and beliefs of pet owners may also have an effect on perceived satiety in dogs. A qualitative study [6] comparing dog owners' and veterinarians' perceptions of obesity and weight loss in dogs revealed many themes from owners' narratives that provide explanation for their dogs' weight, including anthropomorphic tendencies (i.e., owners perceive that their pets share similar human emotions when they believe them to be restricted in food). These anthropomorphic tendencies may also lead owners to inadvertently perceive begging for attention as begging for food due to hunger, further complicating owner perception of satiety. As has been shown in both human and veterinary studies, perception of appropriate meal and portion size can be easily skewed based on external factors, such as larger or smaller food scoops, bowls, and plates [11,12]. Therefore, factors other than true hunger may alter owner feeding habits and perceptions of satiety in dogs.

Improved methods to increase the success of weight loss programs in dogs are needed, and a better understanding of factors that affect owner assessment of satiety and begging behaviors are important to achieve this goal. Therefore, the purpose of this study was to evaluate owner perception of satiety and begging behaviors in overweight client-owned dogs in a home environment. The two main study objectives were 1) to determine if owners would assess their dogs to have increased fullness and decreased begging behaviors while being fed a

high-fiber, high-protein therapeutic diet in comparison to their dogs' usual diet; and 2) to assess whether the description of a therapeutic diet by the veterinarian (i.e., either with a positive or a neutral description) would change how owners assessed their dog's satiety and begging behaviors. We hypothesized that a high-fiber, high-protein therapeutic diet would result in a statistically significant increase in owner assessment of satiety and decreased begging behaviors in dogs when compared to the usual diet. Moreover, we hypothesized that the presentation of the diet by the veterinarian would have a significant effect on owner perception of the dog's satiety while eating that diet.

MATERIALS AND METHODS

This study utilized a randomized, controlled crossover protocol to evaluate owner perception of satiety in overweight dogs.

Study Population

Healthy, client-owned dogs of at least 1 year of age and of any breed with a BCS between 6-9/9 were eligible for the study. Dogs were determined to be in good health by a medical history, physical examination, and no significant laboratory abnormalities (complete blood count, biochemistry profile, T4 concentration,

and urinalysis). Exclusion criteria were current use of the study diet, use of prescription or over-the-counter medications or dietary supplements (with the exception of monthly heartworm, flea, or tick preventatives), and evidence of current medical conditions. A diet and medical history form was completed by all owners at the time of enrollment. This study protocol was reviewed by the University Clinical Studies Review Committee. All owners signed an informed consent form prior to enrollment in the study.

STUDY PROCEDURES AND PROTOCOL

Screening Visit

At baseline, a physical examination, body weight, BCS, and muscle condition score (MCS) were performed. Dogs were weighed on the same scale to the nearest 0.1 kg. BCS, using a 1-9 scale described in previous studies [13], and MCS (defined as normal muscle condition, mild muscle wasting, moderate muscle wasting, or marked muscle wasting [14], were assigned to all dogs based on assessment by a single investigator (DL). Blood was collected by jugular venipuncture and urine was collected via free catch into a sterile cup for complete blood count, biochemistry profile, T4 concentration, and urinalysis.

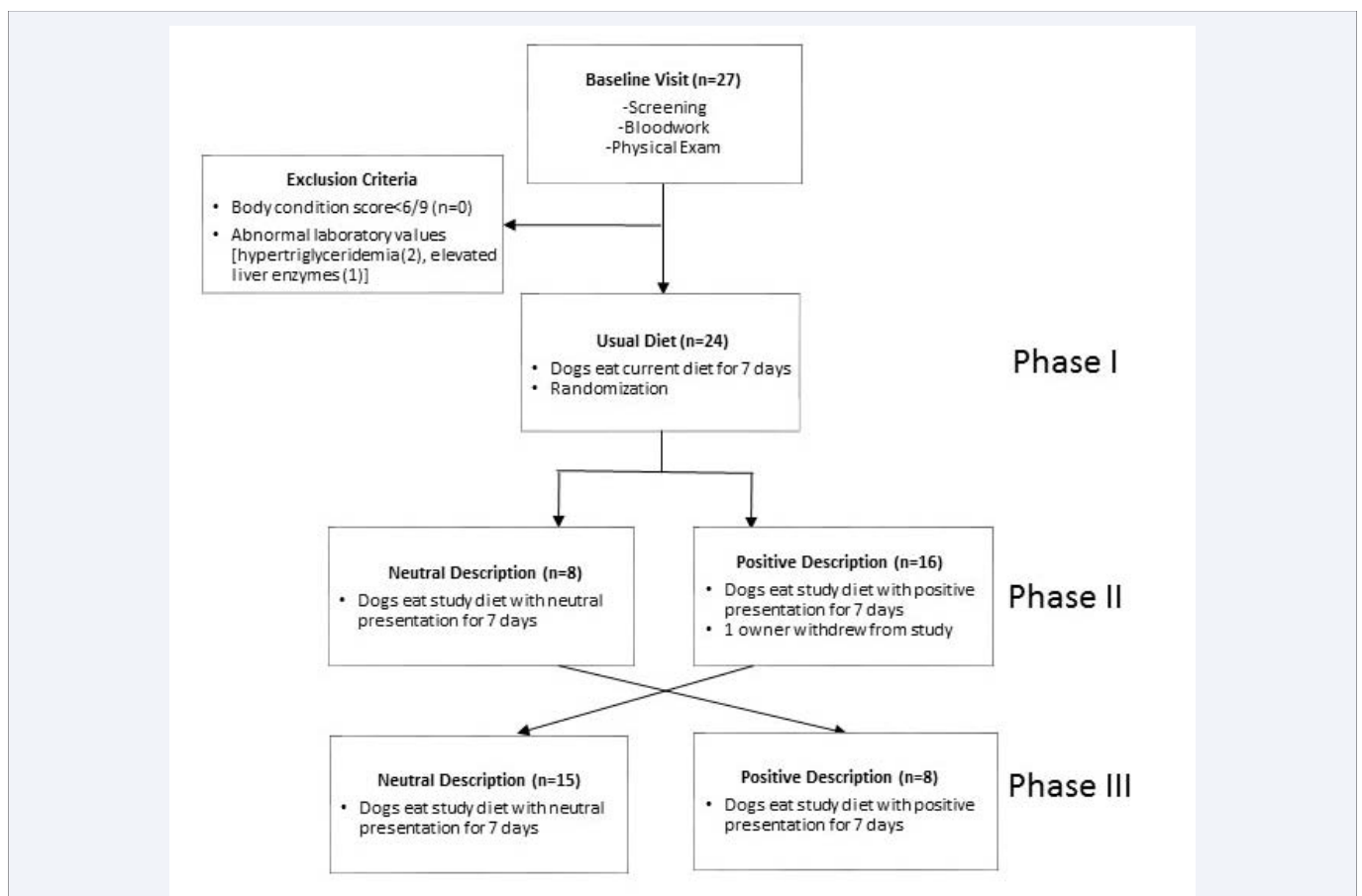


Figure 1 Study timeline and protocol for a study assessing the effects of diet on owner perception of satiety and begging behaviors in 23 overweight dogs. Calorie intake to meet resting energy requirement for current body weight was used for all 3 phases of the study. A 5-day period between each phase was used to transition to the new diet. For the positive presentation, owners were told that the study diet was specially formulated to help keep dogs feeling full and for the neutral presentation, owners were given the study diet without any special presentation.

Intervention Protocol

The study was divided into 3 phases, each 7 days in duration and with a 5 day transition between each phase (Figure 1). In Phase I, owners were instructed to feed their dog its usual diet at the calculated amount. In Phases II and III, owners were instructed to feed their dog 1 of 2 'study diets' in succession, in a randomized order. However, the 'study diet' was actually the same for Phases II and III, but was packaged in unlabeled bags with different codes so that the owner would remain blinded to the specific product or company name of the diet throughout the study. All participants were evaluated at the end of each diet phase for a body weight, BCS, and a weekly satiety survey (4 visits total). Dogs were randomized to the sequence of the diet using a computer generated number randomization method, thus the proportion receiving each diet first were created at random.

Phase I (Usual Diet)

After ensuring eligibility, owners were instructed to feed the dog's usual diet for 7 days at a daily amount to meet calculated resting energy requirement (RER) for the dog's current body weight ($70 \times BW_{kg}^{0.75}$ kcal/day) divided into 2 daily meals. Owners could feed up to 10% of the total calorie intake per day from treats (i.e., a dog requiring 1000 kcal/day could be fed up to 100 kcal/day in treats and 900 kcal/day from the study diet).

Phase II and III (Trial Diet)

After completing Phase I, all dogs were randomized in a crossover design using a computer generated randomization table to start with the positive or the neutral presentation. Phases II and III were each 7 days in duration with a 5 day dietary transition period between each phase (i.e., 5 days between Phases I and II, and 5 days between Phases II and III). For Phases II and III, dogs were fed the same high-fiber, high-protein, nutritionally balanced dry diets (Table 1), but the diet was presented differently depending on which presentation the owners were randomized to first (positive or neutral presentation). For Phase II, owners randomized to receive the positive presentation first were told that the study diet was specially formulated to help keep dogs feeling full (positive presentation), while the owners who were randomized to receive the neutral presentation first were

given the study diet without any special presentation (neutral presentation). To keep the presentations consistent, a script was used by the same investigator for each presentation. For the positive presentation, the study script was as follows: "For this part of the study, we are excited to have you try this study food. Researchers have developed a special fiber blend for this food that make dogs feel more full. We'd love to hear how your dog does on this. You get to feed your dog x cups twice daily on this food. Please continue to fill out surveys and we look forward to hearing how it goes." For the neutral presentation, the script was as follows: "For this part of the study, you will feed Diet E. Please feed x cups twice daily and fill out the daily online surveys."

At the end of Phase II, all dogs were crossed over to the alternate group to receive the other presentation (positive or neutral), again with a 5 day transition to the "new" diet, and owners were instructed to feed the study diet exclusively for 7 days for Phase III. For Phases II and III, owners were provided with a list of low calorie treats with specific instructions that they could feed up to 10% of the total calorie intake per day from these treats (i.e., a dog requiring 1000 kcal/day could be fed up to 100 kcal/day in treats and 900 kcal/day from the study diet).

Owners were asked to keep a daily log of the amount of food and treats fed to assess compliance. At baseline and at the end of each study phase, owners completed a 13-question survey on their dogs' begging behaviors and perceived satiety. The survey asked owners to rate various satiety and begging behaviors (e.g., begging, barking or whining to be fed, stealing food, eating rapidly, acting hungry, satiety after eating) on a 1-5 Likert Scale (Figure 2).

Outcomes and Data Analysis

The primary outcomes were the owner scores on each of the 13 questions about dogs' begging behaviors and satiety comparing results at the end of Phase I (usual diet) to those from the end of the study phase in which the dogs received a neutral presentation of the study diet (diet effect) and between positive and neutral presentations of the study diet (presentation effect). The baseline scores for begging and satiety behaviors for each dog (consuming their usual diet in the usual amounts) was performed to include this individual effect as a covariate in each subsequent statistical model.

Linear mixed models were performed using either diet effect or presentation effect with order effect (i.e., whether they completed the positive or neutral presentation first) and the respective interaction between presentation x order effects as fixed effects. Moreover, in each model, the related initial assessment of begging or satiety behaviors for each dog was added as covariate and dog effect was modelled as a random term. When the residuals distribution of a model was not normally distributed, begging or satiety scores were ranked to perform a non-parametric analysis. False discovery rate adjustment was performed to correct P values for multiple comparisons within each category of answers (begging or satiety behaviors). Data are presented as mean \pm standard deviation or median (range), depending on whether the data were normally distributed or skewed, respectively. Commercial statistical software was used for all analyses (SAS 9.3 software, SAS Institute Inc., Cary, NC, USA). $P < 0.05$ was considered statistically significant.

Table 1: Partial nutritional profile of extruded (dry) study diet fed during phases II and III of a study assessing the effects of diet on owner perception of satiety and begging behaviors in 23 overweight dogs.

	Diet Profile* (per Megacalorie)
Kilocalories/kilogram	2900
Kilocalories/cup	244
Crude protein (grams)	103.4
Crude fiber (grams)	55.9
Total dietary fiber (grams)	96.5
Total fat (grams)	32.8
Moisture (percent as fed)	10.0
Crude ash (percent as fed)	5.3

*Royal Canin Veterinary Diet® Satiety Support (canine). Royal Canin, USA, Inc., St. Charles, MO, USA.

How often does your dog show the following behaviors?	Never	Rarely	Sometimes	Often	Always
Barks or whines for food or treats	1	2	3	4	5
Runs to bowl expecting food	1	2	3	4	5
Wakes you up at night to be fed	1	2	3	4	5
Follows you around the kitchen	1	2	3	4	5
Begs at your table or stares while you are eating	1	2	3	4	5
Steals food, gets into trash, tries to open doors or cabinets	1	2	3	4	5
Eats rapidly, immediately begs for more	1	2	3	4	5
Based on your dog's behavior, please rate the following statements.	Strongly disagree	Disagree	Neither	Agree	Strongly Agree
My dog acts hungry all of the time.	1	2	3	4	5
My dog begs for food and treats all of the time.	1	2	3	4	5
My dog finishes all food that is offered all of the time.	1	2	3	4	5
My dog feels full after eating a meal.	1	2	3	4	5
My dog is a picky eater.	1	2	3	4	5
My dog has to have food and treats that he/she likes to be happy.	1	2	3	4	5

Figure 1 Questions included in a survey assessing the effects of diet on owner perception of satiety and begging behaviors in 23 overweight dogs.

RESULTS AND DISCUSSION

Results

Twenty-four overweight and obese dogs were enrolled in the study. One dog was withdrawn from the study during Phase II because of constipation (the dog had a history of pelvic fractures), so 23 dogs completed the study (12 female and 11 males, all neutered; age = 6.5 ± 2.4 yrs). The remaining results will be reported only for these 23 dogs. Breeds included mixed breed (n=8), Chihuahua (n=4), golden retriever (n=2), Jack Russell terrier (n=2), and 1 each of the following: Beagle, Boston terrier, Cocker spaniel, coonhound, Labrador retriever, shih-tzu, and Pembroke Welsh corgi. Median weight at the beginning of the study was 14.1 kg (range, 2.5-55.5 kg) and distribution of BCS was 6 (n=6), 7 (n=8), 8 (n=5), and 9 (n=4). MCS in all dogs was normal. Median body weight did not change significantly over the course of the study: Baseline: 14.1 (2.5-55.5 kg); end of phase I: 13.8 kg (range, 2.6-54.6 kg); end of phase II: 14.1 kg (range, 2.6-53.0 kg); end of phase III: 13.7 kg (range, 2.5-51.4 kg).

When comparing the dogs' usual diet versus neutral presentation of the study diet (both at amounts to meet RER for current body weight), there were no significant differences for any of the 13 survey questions regarding begging behaviors and satiety ($P = 0.16-0.75$). Similarly, when comparing the positive versus neutral presentations of the study diet, there were no significant differences for any of the 13 survey questions regarding begging behaviors and satiety ($P = 0.31-0.99$).

Discussion

Owner perception in this study of satiety and begging behaviors in dogs varied widely and did not differ significantly based on diet or presentation of diet. When dogs were fed at RER for current body weight, owners' perceptions of begging behaviors and satiety for the study diet were not significantly different from those while dogs were eating their usual diet. Based on some previous studies that have shown increased satiety with

high-fiber diets, the hypothesis of the study was that a high-fiber, high-protein veterinary therapeutic diet would improve owner-perceived satiety in overweight dogs. The results of the study did not support this hypothesis; there are several potential explanations for this finding. Most importantly, while most previous studies were conducted in dogs housed in a colony, the current study used owner observations to assess dogs' satiety. Begging behaviors and satiety in dogs may be multifactorial, including physiologic factors (i.e., leptin resistance in overweight dogs) and behavioral factors (i.e., to receive attention vs food), which are not markers of true satiety. Owner perception may not be a good measure of true physiologic satiety and additional research is needed in this area since owner perception likely influences success in weight loss programs for dogs. Additionally, further research is needed on validated tools to assess owners' 'perception of dogs' satiety.

Another issue that may have limited the ability to detect a diet effect was sample size. Owner-perceived satiety has not been reported for previous studies of similar design; therefore, an accurate *a priori* sample size calculation was not possible. Although not significant, some trends in the current study suggest that additional studies using a larger sample may be useful. Due to a lack of previous studies on owner-perceived satiety, it was also challenging to determine the appropriate length of time for each phase of the diet trial. In the authors' clinical experience, owners that dislike a new dietary therapy or feel it is not working for their pet will notify their clinician within the first week, so this duration was chosen to assess pet owners' initial impression of the diet. It is not known if the perception of owners would change if each phase were longer in duration, and could be explored in future studies. Additionally, at baseline, dogs were eating a variety of different diets that were used as control comparisons to the study diet. This variation also could have contributed to a lack of a significant difference.

Another possible explanation for these results was the degree of calorie restriction used. Though recommendations for calorie

restriction in weight loss vary, the median calorie intake from feeding directions for foods marketed for weight management in dogs was 1.0 x RER for current weight (range 0.73-1.47 x RER) [15]. This was the rationale for using RER for current weight for daily calorie intake in the current study. However, clinically, more calorie restriction is typically required for successful weight loss. The results of the current study, in which there was no significant change in weight status over the course of the study, support this finding that RER for current body weight is not sufficient to achieve weight loss in most dogs. However, an additional rationale for using current body weight was to minimize variation in calorie restriction among the participants. If ideal weight were used for all dogs, those only mildly overweight (BCS of 6/9) would only have minimal calorie restriction, while those markedly obese (BCS of 9/9) could have severe calorie restriction. This difference in calorie restriction could greatly affect their satiety and begging behaviors and thus results may not be comparable between dogs requiring different levels of calorie restriction. In order to keep the level of calorie restriction even among all dogs, current weight and not ideal weight was used for energy calculations. It is not known if using more severe calorie restriction during the study or a longer study would have had different results. Future studies are recommended in which this diet is used during active weight loss and with appropriate sample size to compare results between dogs requiring different levels of caloric restriction.

The second hypothesis of the study was that a positive presentation of the study diet would improve owner perception of their dog's satiety compared to a neutral presentation of the same diet. The data did not support this hypothesis of a presentation effect on perceived satiety in dogs. While previous studies have assessed owner education components [5,16], there is a lack of veterinary literature evaluating the effect of presentation of diet and treatment options. Although not a diet study, this type of effect has been seen in a human study, in which hotel room attendants perceived their health to be better and lost more weight compared to a control group simply after being told their work was exercise and met guidelines for an active lifestyle [17]. In addition to the possible explanations previously described, blinding might not have been successful and owners may have realized that the diets for the positive and neutral presentation were actually the same diet. This appears unlikely as no owners asked if the diets were the same throughout the study. Compliance also could have affected the results. Although owners were asked to keep a daily log of the amount of food and treats fed to assess compliance, the self-report was not verified. Development and validation of an accurate assessment of owner-perceived satiety in dogs would also have strengthened this study. As no such validated scale exists, the 13 questions used in the current study were based on the authors' clinical experience with owners of overweight dogs.

CONCLUSION

Though the initial hypotheses of the study were not supported by the results, the wide individual variation seen in scores among owners for the survey questions provides valuable information. For nearly every question on the 13 item survey, the responses ranged from 1-5 on the 1-5 Likert scale. This suggests that there is either wide variation in dog behaviors or wide variation in

owner perception of satiety based on these behaviors. While in this study, this variation may have been an explanation for lack of statistically significant results, the dog to dog (and owner to owner) variation suggest that a 'one-size-fits-all' weight loss strategy is unlikely to be successful. Understanding dog behaviors and owner perceptions of these behaviors may be helpful for veterinarians in creating individualized weight loss plans. Assessing information on owner-perceived satiety and dog behaviors at the beginning of a weight loss program could help to identify problem behaviors (e.g., waking the owner up at night or begging for food) that would need to be addressed. Additional studies on this aspect of canine obesity are warranted and may provide useful information for successful weight loss programs.

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