Insights from 10 Years of Clinical Research on Pet Obesity: What Can We Do Better?

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Abstract

Canine obesity is arguably the biggest health and welfare issue currently affecting pet dogs and cats. Although successful weight loss has health benefits, current strategies are far from ideal. Many obese dogs and cats that start a weight program fail to lose weight or subsequently regain the weight they have lost. Therefore, new approaches are needed in order to maximize success of weight-management regimes in the future. This talk will summarize key findings from 10 years of clinical research at the Liverpool Weight Management Clinic and use these to present a framework for improving success by better tailoring weight-management regimes to the individual.

Glossary of Abbreviations
DEXA: Dual Energy X-Ray Absorptiometry
MER: Maintenance Energy Requirement
SBW: Starting Body Weight

The Significance of Obesity in Pets

The medical profession now classifies human obesity as a disease.[1] Similarly, the veterinary profession now recognizes obesity to be the most important medical disease in dogs,[2] with recent studies suggesting half of all pets to be overweight,[3,4] a prevalence that has been increasing steadily.[5] Obesity predisposes dogs to many diseases, including orthopedic conditions, diabetes mellitus, respiratory illnesses, and certain type of neoplasia.[2,3] Other studies have demonstrated that overweight dogs have a shorter life span.[6] Given the massive at-risk population and the effects on health and quality of life, obesity is a major welfare concern. Most veterinarians recognize the need for obese animals to undergo controlled weight loss to prevent associated diseases from developing and/or to reduce severity of existing problems. Although licensed drug therapies are now available for canine obesity,[7,8] the most common method for managing obesity involves caloric restriction using a purpose-formulated weight-loss diet.[9-11]

Research Conducted in Colony Animals

Ten years ago, information on obesity and weight management was more limited, and most research work was undertaken using colony dogs and cats that often were made overweight in the short term through overfeeding. Such studies demonstrated that weight-management strategies could be very successful, with expected rates of weight loss of 1.3-2.6%/wk when restricting caloric intake to 50-87% of maintenance energy requirements (MER). From such studies, it was clear that the main factor that influenced the rate of weight loss was the level of caloric energy restriction. That said, while the protein content of the diet does not affect the rate of weight loss, it can influence the amount of lean tissue loss during weight management, with high-protein diets minimizing such losses. Although there are many advantages to such studies, most notably in consistency and control, they are arguably somewhat divorced from obesity in pets and weight management in the "real world."

The Liverpool Weight Management Clinic

Ten years ago, a weight management referral clinic was established at the University of Liverpool's Small Animal Teaching Hospital. The clinic, which officially opened in early 2005, remains one of the only referral services in the world designed exclusively for weight management of cats and dogs. In establishing the service, there were three main aims:

- To treat companion animals with obesity and related disorders
- To undertake clinical research in the field of companion animal obesity
- To disseminate information about companion animal obesity to veterinary professionals, pet owners and the public at large

The weight-management process at the Liverpool weight management clinic includes the following:

- **Preliminary case screening.** Prior to the appointment, a clinical history is obtained from the primary veterinarian, and a questionnaire posted to the owner. The questionnaire allows initial data on the family unit, feeding and exercise to be acquired. The prescreening questionnaire can be used to plan the approach to the case and helps form the basis for information discussed during the first appointment.

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- **First appointment.** A number of activities are conducted:
  - *Initial consultation and clinical evaluation.* All aspects of the patient's lifestyle are discussed, and information is gathered regarding any previous medical history. Body weight is measured using calibrated scales, photographs are taken, and morphometric measurements are gathered.
  - *Clinicopathological evaluation.* Routine haematological examination, serum biochemical analysis, and urinalysis are conducted in all cases. In addition, serum-free thyroxine concentration is measured in dogs.
  - *Indirect blood pressure measurement.*
  - *Body composition analysis.* Dual-energy X-ray absorptiometry (DEXA) is used to enable the degree of adiposity to be precisely determined.
  - *Weight-management plan determined and discussed.* A conventional approach is adopted using dietary caloric restriction and activity.
- **Weight-loss phase.** After the initial appointment, regular contact is maintained with the client by phone, email and in person. The weight-loss phase can last a variable amount of time (but typically 6-18 months). Patients undergo regular weight and morphometric checks, and adjustments are made to the plan, as required.
- **Full re-evaluation.** When the case has reached its target weight, a complete re-evaluation is performed, which includes repeat clinicopathological testing, blood pressure measurement and DEXA.
- **Weight-maintenance phase.** Once the target weight is reached, the plan is gradually adjusted (typically by steadily increasing food intake) until weight stabilizes. The dog or cat is then monitored periodically thereafter to ensure there is no weight regain.

The approach taken ensures that all cases recruited to the clinic are well phenotyped and that the outcomes of weight loss and the maintenance process can also be assessed in fine detail. Not only does this help to maximize the success of the weight-loss process, it also facilitates the collection of a wealth of data for research into obesity and the weight-loss process.

The Liverpool Weight Management Clinic as a Cohort Study for Research

The design of the clinic enables a rolling cohort of obese pet dogs and cats to be recruited, monitored during their weight-management program, and then followed up to determine their outcome. The weight-management process can then be studied in two ways:

1. **The effect of weight management on obesity in pet dogs and cats.** The Liverpool Weight Clinic Cohort can be used to assess the effect of weight management on various clinical and physiological parameters in obese dogs and cats. Here, cases that succeed with weight loss and reach their target weight are studied, with the individual cases acting as their own controls.
2. **Success versus failure of weight management.** Since not all cases reach their target weight, the Liverpool Weight Clinic Cohort also can be used to study differences among cases that succeed and those that fail the weight-loss process. This enables us to determine factors associated with successful weight loss.

It is this dual approach, combined with the excellent case phenotyping, that has enabled many aspects of the weight-management process to be studied in far greater depth than has been possible before. While research conducted using client-owned animals arguably produces results more representative of "real life" weight loss, this approach does have its limitations. First, the cohort recruited is highly variable in terms of signalment, presence of associated diseases and owner factors. This raises the possibility that confounding factors can influence outcomes, increasing the variability of the results obtained. Second, the use of client-owned dogs places limitations on the type of research that can be performed. In this respect, all associated studies must first receive ethical approval from the University of Liverpool Research Ethics Committee, and only procedures that are noninvasive or conducted for the direct benefit of the patient are allowed. In the author's opinion, these limitations are more than outweighed by the benefits of obtaining data from pet dogs and cats with naturally occurring disease. Indeed, to date, approximately 30 peer-reviewed scientific publications involving the clinic cohort already have been published, and key aspects of this research are covered below.

'Real Life' Weight Loss

As mentioned above, the results of weight-loss research conducted using colony dogs suggest that the weight-loss process is almost universally successful, with weight-loss rates of 1-2%/wk readily achievable when animals are restricted to 50-87% of their maintenance energy requirement. Studies conducted using the Liverpool Weight Clinic Cohort have demonstrated that weight loss in client-owned dogs is slower (typically between 0.5-1% of starting body weight [SBW] per week) and requires a greater degree of energy restriction (e.g., for dogs, a median of 52% of MER at target weight).[10] Similar studies have been conducted in obese pet cats, in which an average rate of weight loss of 0.8% SBW/wk was demonstrated.[13] Both canine and feline studies also demonstrated that owner compliance is likely to be a major factor in success, with dietary noncompliance being a major contributing factor. Indeed, based on self-reports from diary records, owners of dogs and cats undergoing weight loss gave additional food (e.g., treats and table scraps) against veterinary advice during the weight-loss program, and this could represent as much as 10% of MER.[10,13] While this

noncompliance is likely to be multifactorial, one important factor is likely to be that energy restriction causes hunger, leading to increased begging and scavenging activity. In light of this, attempts have been made to develop alternative dietary strategies to improve satiety, for instance, altering macronutrient profile by including more protein and fiber (relative to energy content), which have a satiating effect in dogs.[14] Work at the Liverpool Weight Management Clinic has demonstrated improved outcomes in dogs, with faster rates of weight loss and greater fat loss than with conventional diets.[11] However, given that protein content is a key determinant of voluntary food intake in cats, the best effect on satiety occurs with fiber supplementation, while only modestly increasing protein content.[15]

A number of weight-loss studies have assessed body composition, and many infer that tissue mass is exclusively lost from the adipose tissue compartment. However, the majority of such studies have only examined modest amounts of weight loss (often 10-20%). Studies from the Liverpool Weight Clinic Cohort have contradicted these findings and revealed that some lean tissue loss is inevitable in most cases. The discrepancy between earlier colony studies and those from the Liverpool cohort can readily be explained by the fact that significantly more weight loss is required to return obese pet dogs and cats to their ideal weight than is typically assessed in a colony study. For example, the median (range) percentage weight loss in dogs attending the Liverpool clinic is 25% (range 6-44%),[16] and similar degrees of weight loss are seen in cats. Body composition studies have revealed that the proportion of weight lost as lean tissue increases proportionately in relation to the overall degree of weight lost. Thus, minimal lean tissue loss is expected in dogs and cats losing 5-15% of body weight, but lean tissue loss can be considerable for patients losing >20% of their starting body weight.

Benefits of Weight Loss

Many studies have demonstrated that the health of obese dogs improves after weight loss. For instance, modest weight loss (5-10%) can lessen the severity of associated diseases such as osteoarthritis.[17,18] Studies from the Liverpool Weight Clinic Cohort have also demonstrated the benefits of weight loss. Metabolic derangements occur in dogs and cats that are overweight, and these improve with weight management.[19,20] Recent clinic studies in dogs have also suggested that obese dogs have altered renal function and respiratory dysfunction (causing poorer oxygenation), both of which improve with successful weight management.[21,22] Finally, health-related quality of life is worse in dogs in the obese state, and this can influence the success of weight management.[23] Successful weight loss also can improve various aspects of quality of life, most notably those relating to mobility.

The Rebound Phenomenon and How to Prevent It

Finally, a fault of most studies on weight management is that they only look at the weight-loss phase, and many only look at its initial stages. Arguably, success should not be judged by the initial weight loss but through maintaining weight loss in order to sustain the benefits. In humans, long-term success of weight management strategies is disappointing, with some studies suggesting that some participants on diet-based weight-loss strategies regain more weight than they had originally lost. A recent study at the Liverpool Weight Management Clinic has examined long-term follow-up in obese pet dogs that had successfully reached target weight: 42% of dogs maintained weight, 9% lost further weight, and 48% regained weight.[24] Dogs fed a purpose-formulated weight-management diet during the weight-maintenance phase regained less weight than those switched to a standard maintenance diet. In a similar study in cats, age was the principle factor associated with weight regain, with younger cats (<9y age) more likely to rebound.[25] These studies highlight that weight management is a lifelong process, with clinicians needing to continue to monitor body weight after ideal weight has been achieved.

Overall Success of the Weight-Management Process

A wealth of information is now available regarding obesity in dogs and cats and the outcomes of weight management. However, most studies are of short duration, assessing the initial phase of weight loss (e.g., first 2-3 months).[7,8,18] As a result, simple outcomes are studied, such as the rate of weight loss, percentage of weight loss and energy intake during weight loss. As discussed above, such studies are often inadequate and do not give a realistic impression of the weight-loss process in pet dogs and cats. Arguably, studies that assess the whole of the weight-loss period and beyond are more desirable,[24] as well as studies that assess more important outcomes such as the success of reaching and maintaining target weight.

In a recent study, the records of obese dogs attending the Liverpool Weight Management Clinic were reviewed, and cases were classified according to their outcome (i.e., whether or not they had completed or stopped their program).[16] Factors associated with the likelihood of success were assessed with simple and multiple logistic regression. Of the 143 dogs included in the study, 86 (60%) completed the program. The remaining dogs did not reach target weight; 11 (8%) died or were euthanized (for unrelated reasons), and 46 (32%) stopped participating. Reasons for dogs stopping the program included the inability to contact the owner, refusal to comply with requirements for weight management, and development of another illness. Simple and multiple logistic regression analysis revealed that dogs fed a dry weight-loss diet were

more likely to complete the program that those on wet food or a mix of wet and dry food (p=0.011), while dogs with a greater starting body fat were less likely to complete the program (P=0.03). No other associations were identified. The key conclusion of this study is the fact that the most obese dogs are more likely to fail on a weight program, but success is better with some diets. Further investigations are needed to clarify the reasons for success.

Detailed Kinetics of the Weight-Loss Process

As mentioned many times already, most existing studies assessing weight management in obese dogs and cats only examine the early stages of weight loss, and this does not properly reflect the complete weight-management process. Further, such studies often report outcomes in terms of simple summary statistics, such as the rate of weight loss, and these figures may be highly misleading. In light of this, the latest work conducted at the Liverpool Weight Management Clinic has examined the kinetics of a complete weight-management cycle in obese client-owned dogs.[26]

The entire Liverpool Weight Clinic Cohort was eligible for inclusion, and dogs were followed until they had either completed (i.e., reached target weight) the program or the program was discontinued. Rate of weight loss, percentage of weight lost and energy were assessed at different time points during the process. A total of 149 dogs were included, with a range of breeds, ages and sexes represented. Rate of weight loss steadily decreased throughout the weight-loss period (d28: 1.2 ±0.67%/wk; d56: 0.8 ±0.6%/wk; d84: 0.7 ±0.5%/wk; d168: 0.5 ±0.4%/wk; d252 0.4 ±0.3%/wk; d672: 0.1 ±0.1%/wk; P<0.001). The energy intake required to maintain weight loss also progressively decreased (p<0.001). By day 84, mean ±sd weight loss was 11±4.9% and compliance was good, but most had not completed (1% completed, 86% ongoing, 13% discontinued) the program. Thereafter, more dogs completed the program, but the number discontinuing participation also increased (d252: 20±7.7% weight loss, 32% completed, 41% ongoing, 27% discontinued; d672: 25±14.6% weight loss; 59% completed, 4% ongoing, 37% stopped).

These results highlight the fact that initial weight loss is good in obese dogs undergoing weight management, but response steadily worsens thereafter. It also confirms the fact that unless the complete weight-loss cycle is examined, outcomes based on simple summary statistics can be misleading.

How Can We Do Better?

As described above, the 10 years of research on the Liverpool Weight Clinic Cohort, in conjunction with other excellent work in the field, has revealed key insights into obesity in pet dogs and cats and the realities of the weight-management process. These findings can be used as a basis for determining how pet obesity is best approached in the next 10 years and how success can be maximized. In designing a new approach to weight management, the following clinically proven facts should be considered:

- **Benefits of weight loss are many and varied.** The known benefits include increasing life span, preventing the development of obesity-associated diseases, lessening the impact of existing medical conditions and physiological derangements, and improving overall quality of life.
- **Weight management is challenging for owner and pet.** Weight management in pet dogs and cats is more challenging than suggested by research colony studies. Weight loss progresses more slowly, and marked energy restriction is required. The rate of weight loss declines steadily during the weight-management process and requires steadily more energy restriction.
- **Weight management leads to loss of lean tissue.** Lean tissue loss is inevitable during the weight-loss process but is minimal with weight loss of 10% or less and most marked for dogs and cats losing more than 20% of body weight.
- **Not all obese dogs and cats succeed in losing weight.** Only half of the dogs and cats commencing a weight program succeed in reaching target weight. Compliance is good in the early stages of weight loss, with the dropout rate increasing steadily throughout the weight-loss process. Therefore, dogs and cats with the most weight to lose are least likely to be successful.
- **Most dogs and cats lose some weight even if they don't reach their target weight.** Although many dogs and cats are unsuccessful, 90% will lose some weight in the early stages, typically 10-15% in the first two to three months.

Most importantly, the weight-loss process in obese dogs and cats is a clear example of diminishing returns. The more weight that must be lost, the more difficult it is; the payoff of success in these circumstances is dramatic energy restriction and the likelihood of considerable lean tissue loss. In the author's opinion the process of tailoring weight management to the individual is key to maximizing success. This concept involves understanding the priorities for weight management for each case, setting case-specific targets, and establishing a realistic plan that will maximize the chance of successfully achieving the agreed target and then maintaining any benefit over the long term. Two case examples can demonstrate the application of tailored weight management to the individual.

CASE 1: *1y7m Female Corgi, with no associated diseases, that is 40% above ideal weight*

Recommendation: A weight-management program aiming to return the dog to her ideal body condition and maintaining ideal body condition long term.

Rationale: Given the early onset of obesity, this dog will have a lifelong risk of gaining weight. Thus, early recognition of obesity and lifelong weight management is critical in this case.

Returning such a case to optimal body condition (BCS 4-5/9), and maintaining this, will maximize the likelihood of positive effects on longevity and reduce the chance of obesity-associated diseases arising in the future.

CASE 2: *9y7m Neutered Male Labrador Retriever, with severe multi-joint osteoarthritis, that is 30% above ideal weight*
Recommendation: Partial weight-loss regime, initially aiming for ~10% of body weight loss.
Rationale: Given the dog's age, it is unlikely that returning the dog to his ideal condition will dramatically extend life span. The dog also has severe, coexisting disease, so while other conditions might be prevented, this is less of a priority than for Case 1. Instead, the main priority for weight management should be to lessen the impact of existing diseases. The initial target for weight loss of ~10% is recommended in light of the fact that this is sufficient to improve mobility yet is far more realistic than complete weight loss. Such a target is reached in at least 80% of cases within ~3 months. If progress is good at that stage, further weight loss could then be considered, which will further improve mobility and overall quality of life.

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