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Understanding and Managing Obesity in Dogs and Cats

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Obesity is qualitatively defined as an excess of body fat sufficient to contribute to disease [1]. In human beings, this is recognized as a body weight at least 20% greater than ideal, where the excess body weight is attributable to an accumulation of adipose tissue [1]. This degree of excess body weight seems to be important in dogs as well.

Obesity is a common problem in dogs and cats. Numerous studies in developed countries suggest that between 25% and 40% of adult cats and dogs are overweight or obese [2–6]. An even higher prevalence occurs in dogs and cats between 5 and 10 years of age. Although the incidence of obesity in pets seems to be increasing, data to support this perception are currently lacking.

HEALTH RISKS OF OBESITY

Obesity has been associated with a number of diseases (Table 1) [3,5,7–19] as well as with a reduced lifespan [1,7,15]. A lifelong study in dogs showed that even moderately overweight dogs were at greater risk for earlier morbidity and a shortened lifespan [7]. Likewise, in cats, adverse effects were observed in moderately overweight cats, increasing in prevalence as the degree of obesity worsened [3,5]. In cats and dogs, the strongest associations are with diabetes mellitus and osteoarthritis. Data suggest that 31% of diabetes mellitus and 34% of lameness could be eliminated if overweight and obese cats were at optimum body weight [3].

The impact of excess body weight in dogs was best illustrated in a 14-year study by Kealy and colleagues [7]. In that study, one group of Labrador Retrievers was fed 25% less food than their sibling-pairmates throughout life. The average adult body condition scores (BCSs) for the lean-fed and control dogs were 4.6 $\pm$ 0.2 and 6.7 $\pm$ 0.2, respectively, based on a nine-point BCS system [7]. Thus, the control dogs were moderately overweight (typical of many pets) and actually weighed approximately 26% more, on average, than the lean-fed group. The lean-fed dogs were well within the ideal body condition of 4 to 5 on this nine-point scale. The difference in body condition was

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Table 1
List of diseases associated with obesity in dogs or cats

Species	Pathologic finding	Key references
Cat, dog	Insulin resistance	[8–10]
Cat	Diabetes mellitus	[3,6,8]
Cat	Lameness, no specific cause	[3]
Dog	Hip dysplasia	[7]
Dog	Osteoarthritis	[7]
Cat	Dermatopathy	[3,6]
Cat	Oral disease	[6]
Cat	Lower urinary tract diseases	[6]
Cat, dog	Increased inflammatory mediators	[10,11]
Cat, dog	Cardiovascular changes	[12–14]
Cat, dog	Reduced longevity	[7,15]
Dog	Renal pathology	[16–18]
Dog	Pancreatitis	[19]

sufficient to create significant differences between the groups in median lifespan, which was 13 years for the lean-fed dogs compared with only 11.2 years for the control group, a difference of approximately 15%. An impressive correlation between the BCS at middle age and longevity in these dogs showed that even moderately overweight dogs were less likely to live beyond 12 years of age (Fig. 1) [20]. In addition, the onset and severity of hip joint and multiple joint osteoarthritis were delayed or reduced in the lean dogs. Control dogs required medication for chronic health problems or arthritis an average of 2.1 years or 3.0 years, respectively, sooner than their lean-fed siblings [7].

Recent research has suggested a mechanism for the link between excess body weight and many diseases. It seems that adipose tissue, once considered to be physiologically inert, is an active producer of hormones, such as leptin and resistin, and numerous cytokines (Fig. 2) [10,11,21,22]. Of major concern is the production of inflammatory cytokines from adipose tissue, specifically tumor necrosis factor-α (TNFα), interleukins-1β and -6, and C-reactive protein [10,11,21,22]. The persistent low-grade inflammation secondary to obesity is thought to play a causal role in chronic diseases, such as osteoarthritis, cardiovascular disease, and diabetes mellitus [21,23]. TNFα, for example, alters insulin sensitivity by blocking activation of insulin receptors [24]. In addition, obesity is associated with increased oxidative stress, which also may contribute to obesity-related diseases [25–27].

CAUSES OF OBESITY

Obesity is a result of an imbalance between energy intake and energy expenditure, with intake exceeding expenditure. Numerous risk factors that affect this

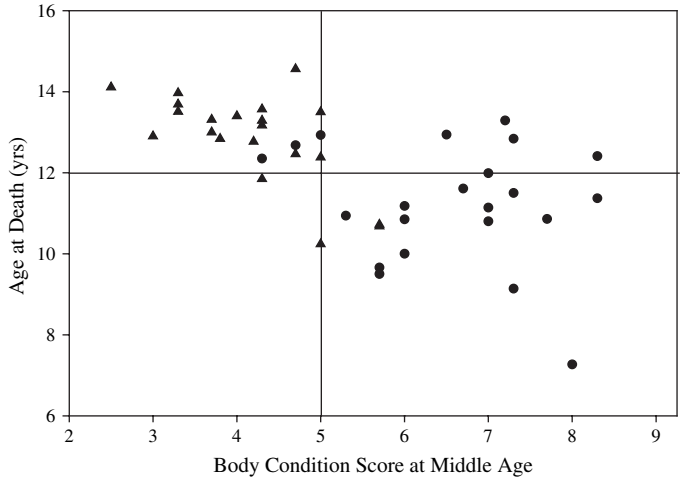

Fig. 1. Effect of body condition on longevity in dogs. The lean-fed dogs (*closed triangles*) received 25% less food than their control group littermates (*closed circles*). The BCS was determined annually using a nine-point system. Data shown are the mean BCS for ages 6 through 8 years for each dog as the independent variable for age at death: Age at Death = 15.208 − (0.589 · BCS) ($R = 0.596$, $P < .001$). Dogs with a BCS of 5 or less at middle age were more likely to live beyond 12 years of age ($P < .001$) compared with dogs with a BCS greater than ideal. (*Data courtesy of* Richard D. Kealy, PhD and Dennis F. Lawler, DVM, Nestle Purina PetCare Company, St. Louis, MO. *From* Laflamme DP. Nutrition for aging cats and dogs and the importance of body condition. Vet Clin North Am Small Anim Pract 2005;35(3):725; with permission.)

balance have been recognized. Neutering is often cited as a contributing factor in obesity [5,6,15,28–35]. Most investigations suggest that neutering results in a decrease in energy requirements [28,31,32,35,36], although some indicate that weight gain is attributable predominantly to increased food consumption [29,34].

Other recognized risk factors for feline obesity include a lack of activity, indoor housing, and feeding high-fat foods [3,5,30]. Interestingly, ad libitum feeding was not associated with an increased risk for obesity [30]. Spontaneous activity tends to decrease with age in cats, which may contribute to obesity [37]. High-fat diets and limited activity are also reported risk factors for obesity in dogs [38].

Less common factors that may play a role in some cases of obesity include endocrine dysfunction (eg, hypothyroidism) and infection-induced obesity. Canine distemper virus was the first infectious agent shown to induce obesity; it does so by downregulating genes for melanin production and disrupting hypothalamic function [39]. A number of additional viruses also have been shown to induce obesity in various laboratory animals [40]. Thus far, such an effect has not been shown to occur in companion animals.

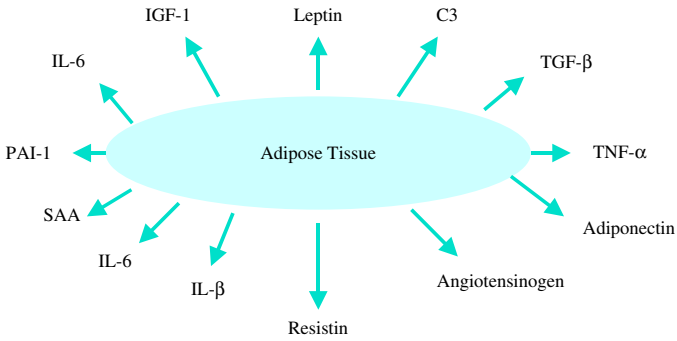

Fig. 2. Hormones, cytokines, and other substances secreted from adipose tissue. This list continues to grow as new substances are identified. [10,11,21,22]. C3, complement protein 3; IGF-1, insulin-like growth factor-1; IL, interleukin; PAI-1, plasminogen activator inhibitor-1; SAA, serum amyloid A; TNF-α, tumor necrosis factor-α; TGF-β, transforming growth factor-β.

DIAGNOSIS

Despite widespread concern about obesity among pet owners, most do not recognize that their own pet is overweight [41,42]. A study of pet cats in New Zealand suggested that owners' underestimation of body condition in their cats was a risk factor for increased prevalence of obesity [41]. Among dogs and cats seen by veterinary practices in the United States, approximately 28% were identified as overweight or obese by their BCS, yet only 2% were diagnosed as obese [4]. As noted previously, obesity is associated with significant health risks; thus, diagnosing and managing obesity are important parts of nutritional management of dogs and cats.

The first step in an effective obesity management program is recognition of the problem. Perhaps the most practical methods for in-clinic assessment of obesity are a combination of body weight and BCS. There are several BCS systems. This author prefers using validated nine-point systems for dogs and cats (a score of 5 is ideal) [43–45]. With these systems, each unit increase in BCS is approximately equivalent to 10% to 15% greater than ideal body weight; thus, a dog or cat with a BCS of 7 is approximately 20% to 30% heavier than its ideal weight. Percentage of body fat (%BF) also can be estimated, as shown in Table 2 [43,44]. By recording body weight and BCS, ideal body weight can be more easily determined. Animals that are becoming obese can be recognized sooner and managed more easily. An illustrated BCS system can provide a useful tool for client education regarding obesity prevention and management.

Other clinical options for assessing excess body weight are zoometric measures. Several such systems have been evaluated but have not been proven more effective than a BCS system for estimating %BF or for identifying overweight animals [46,47]. Zoometric measures, such as abdominal girth (AG), can vary considerably among individuals measuring the same animal [48], and thus should be considered semiquantitative. Because they are designed

Table 2
Estimation of average percent body fat by body condition score

	Cats		Dogs	
Body condition score	Male	Female	Male	Female
5	24	32	17	20
6	29	38	22	26
7	34	43	26	31
8	39	48	31	37
9	45+	54+	35+	43+

Data from Laflamme DP. Development and validation of a body condition score system for dogs: a clinical tool. Canine Pract 1997;22:10–5; and Laflamme DP. Development and validation of a body condition score system for cats: a clinical tool. Feline Pract 1997;25:13–8.

to provide a specific estimate of %BF, however, they may be of value in client communications. Some validated equations include the following:

$$\text{Puppies}: \%BF = 38.369 - 0.064(BMI)$$
$$\text{Cats}: \%BF = 66.715 - 0.061(BMI)$$
$$\text{Dogs}: \%BF = -12.937 + 0.696(AG)$$

where body mass index (BMI) is measured as L^2/W; where length, L (centimeters), is measured from the nose to the base of the tail; weight (W) is measured in kilograms; and abdominal girth (AG) is measured as the circumference at the fifth to sixth lumbar vertebrae [46].

MANAGEMENT: DIETARY FACTORS

Use of an appropriate diet for weight loss is important, and there are several criteria to consider. Although it is ultimately calorie restriction that induces weight loss, it is important to avoid excessive restriction of essential nutrients. Therefore, a low-calorie product with increased nutrient/calorie ratios should be considered. Further, an important goal for weight loss is to promote fat loss while minimizing loss of lean tissue, which may be influenced by dietary composition.

Macronutrients

Fat restriction in weight loss diets reduces calorie density, which helps to reduce calorie intake. Fat contains more than twice the calories per gram of protein or carbohydrate. In a study of obese human subjects, when carbohydrate replaced dietary fat in diets fed ad libitum, weight loss was significantly enhanced [49]. Dogs fed a low-fat and high-fiber diet lost more body fat compared with dogs fed a high-fat and low-fiber diet [50]. Conversely, several human studies have shown that low-carbohydrate diets can facilitate increased short-term weight loss [51–53]. Such diets can alter the selection of foods consumed and greatly reduce intake of sugars and other highly refined carbohydrates,

thus reducing calorie intake. Anecdotal reports suggest that this approach also works in overweight cats. However, feeding of a low-carbohydrate, high-protein diet did not induce weight loss in group-housed cats unless total calories also were restricted [54]. Numerous studies have shown that increasing dietary protein, often in exchange for carbohydrate, has beneficial effects for weight management [55–60]. Most "low-carbohydrate" diets are increased in protein.

Dietary protein is especially important in weight loss diets. Providing low-calorie diets with an increased protein-to-calorie ratio significantly increases the percent of fat lost and reduces the loss of lean body mass in dogs and cats undergoing weight loss [55,60]. Increasing dietary protein from 35% to 45% of energy resulted in more than 10% greater fat loss (1.2 kg versus 1.4 kg fat loss, respectively, for the lower and higher protein diets), despite nearly identical total weight loss and rate of weight loss between groups of cats. Most importantly, absolute loss of lean tissue was reduced by approximately 50% in cats fed the higher protein, low-calorie diet [60]. A similar pattern was observed in dogs, with greater preservation of lean body mass with increased dietary protein during calorie restriction [55,59].

Protein has a significant thermic effect, meaning that postprandial metabolic energy expenditure is increased more when protein is consumed compared with carbohydrates or fats [61,62]. In addition to contributing to a negative energy balance in support of weight loss directly, the thermic effect of protein may contribute to a satiety effect [63]. A higher protein diet helped to sustain weight maintenance after weight loss in human subjects [64]. This effect is likely to apply to dogs and cats as well: two studies have shown that cats fed a higher protein diet at or just below the maintenance energy requirement (MER) maintained a higher level of lean body mass [65,66]. Finally, use of a high-protein diet reduced markers of oxidative stress in obese cats undergoing weight loss compared with those fed a normal-protein diet [27].

Dietary fiber is poorly digestible; thus, it contributes little energy to the diet. Therefore, it can be used to dilute or reduce the calorie density of foods, which can aid in calorie restriction for weight loss [67–70]. Dietary fiber also provides a satiety effect, causing a voluntary reduction in total calorie consumption in dogs offered food in excess of energy needs [68,69]. Cats fed high-fiber foods also voluntarily restricted their calorie intake [67,70].

Water provides another route for diluting calories per volume of food. Thus, canned foods, which contain between 70% and 82% water, may be helpful in some obese patients. Although canned foods typically have a higher fat and calorie content on a dry matter basis, they actually have a lower calorie density per volume as fed compared with dry foods. Use of small cans may aid in portion control. In addition, the lower calories per volume may be especially beneficial when managing overweight cats. In general, animals eat to meet their energy needs. If the energy density of food is altered, they adjust the amount consumed to compensate [71,72]. This adjustment takes some time, however, and it can take many weeks for cats to adjust fully, which can provide a "head start" on weight loss [73].

Other Nutrients and Nutraceutic Agents

Nutraceutic agents and herbal compounds continue to be evaluated for use in weight loss diets. To date, published data on these have been conflicting. Carnitine seems to have received the most attention. Carnitine is produced endogenously from the amino acids lysine and methionine, and facilitates β-oxidation of fatty acids. Supplementation with this compound is likely to be of greatest benefit when the intake of dietary protein or other key nutrients is insufficient to promote adequate endogenous production [74,75]. In semistarved cats and rats undergoing rapid weight loss, L-carnitine reduced hepatic fat accumulation in cats and enhanced lipid metabolism and reduced ketogenesis in rats [76,77]. In human beings, severe calorie restriction resulted in reduced urinary and plasma carnitine, an effect that was attenuated by increased dietary protein during weight loss [78]. With a few exceptions, most studies evaluating carnitine for weight management have shown little benefit [79–82]. In one study, dogs retained more lean body mass when fed a carnitine-supplemented diet but also lost less body weight, whereas another study in dogs showed no significant difference in body composition changes with carnitine supplementation [83,84]. One clinical study in cats demonstrated an increase in the rate of weight loss in cats supplemented with carnitine compared with a control group (24% versus 20%, respectively, over an 18-week period) [48]. The carnitine-supplemented group was initially heavier, however, which may have influenced the rate of loss, and they remained heavier at the end of the weight loss study. Body composition was not analyzed; thus, the effect of carnitine on loss of lean or fat could not be determined in this study [48].

MANAGEMENT: CLIENT AND BEHAVIORAL FACTORS

Once the clinician and owner have recognized obesity in a pet, it is important to develop a management plan that fits the needs of the patient and owner. This must consider client ability and willingness to control calories and enhance exercise for the pet. Numerous options are available; thus, the keys to success are flexibility in design and regular follow-up with the client. Of utmost importance is recognition that individual animals can differ greatly in their MER. Thus, the degree of calorie restriction that induces significant weight loss in one dog or cat may cause weight gain in another [85]. Adjustments in calorie allowance made on a regular basis (eg, every month) can help to address these individual differences as well as the reductions in MER that occur during weight loss [86]. Monthly rechecks also provide ongoing motivation to aid in client compliance [87].

In addition to diet, feeding management and exercise are critically important to successful weight management. Most clients provide treats for their pets. Rather than requiring that they cease this pleasurable activity, the creation of a "treat allowance" equal to 10% of the daily calories provides balance [87]. Clients may be provided with a menu of low-calorie foods or commercial treats that would be appropriate.

Increasing exercise aids in weight management by expending calories. Interactive exercise provides an alternative activity for the pet and owner to enjoy

together rather than food-related activities. Increased activity can enhance weight loss in pets [88,89]. Activity in cats may be enhanced by interactive play or by environmental enrichment with climbing towers, tunnels, multiple food bowls in various locations, and cat-suitable toys. Food balls provide another option. These are plastic balls with holes that dispense kibble or treats as the cat (or dog) plays with the toy. Environmental enrichment and encouragement to play increased activity sufficiently to induce a 1% loss in body weight in overweight cats over a 4-week period without intended calorie restriction [88].

Gradual weight loss in dogs, as in people, is more likely to allow long-term maintenance of the reduced body weight [90]. Weight rebound can be minimized by providing controlled food intake and adjusting the calories fed just to meet the needs of the pet for weight maintenance. Successful long-term weight management may be achieved if clients already accustomed to measuring food and monitoring their pet's weight are encouraged to apply these behavior modifications to long-term weight management [87].

PREVENTION OF OBESITY

Currently, at least 1 in 4 dogs and cats seen by practitioners are overweight or obese [4]. Yet, many pet owners do not realize that their pets are overweight or at risk for health problems. In a survey involving 200 dogs and their owners, it was demonstrated that owners do not recognize their own dog as overweight [42]. In that survey, the mean BCS determined by trained pet experts was 6.3, whereas the mean BCS determined by the dog owners was 5.3. Approximately 27% of the owners underestimated the BCS by two units: two units on this BCS system correlates to 20% to 30% excess body weight [43]. More owners of obese cats inaccurately assessed the body condition of their pet compared with owners of normal-weight cats [41]. Even practicing veterinarians frequently overlook the diagnosis of obesity [4]. Yet, the primary way that many owners recognized their pet as overweight is based on their veterinarian's assessment [91].

Thus, veterinarians should begin or continue to evaluate the BCS of all patients and to discuss with clients the importance of maintaining an ideal BCS. Recording the BCS and body weight in the patient record during every visit allows the veterinarian to discuss trends of weight gain with the owner over time. Veterinarians may want to provide illustrated BCS charts for their clients or to post them within their clinic. A videotape teaching pet owners how to monitor and control BCS can be a valuable client education tool that practitioners may wish to provide.

Large-breed puppy owners, especially, should be taught how to assess the BCS in their puppies and advised to adjust food allowances to maintain a lean body condition while promoting a slow healthy rate of weight gain. Neutering in both genders and in cats as well as dogs is associated with a reduction in energy requirements. All pet owners should be advised to alter the feeding management of their pet after spay or castration. Ideally, all pets should be fed

measured amounts individually. Owners should be advised to use a standard 8-oz measuring cup to determine the volume fed.

To ensure that all essential nutrients are provided despite energy control, it is important that the caloric density of the diet fed be appropriate to the energy needs of the individual pet. Those pets with low energy requirements should be fed products with an enhanced nutrient-to-calorie ratio, such as properly formulated "lite" or weight management diets. High-fat diets tend to be high in calories and are associated with an increased risk for obesity [5,15,38]. In addition, high-fat diets can contribute to adverse metabolic effects, such as altered glucose and insulin responses [92].

Consideration must be given to calories provided from sources other than complete and balanced pet foods so as to reduce the risk of nutrient dilution as well as calorie excess. Clients should be encouraged to develop non–food-related bonding activities, such as leash walking and interactive play, so as to reduce the intake of calories apart from meal times as well as to enhance calorie expenditure.

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